

**PCT**WORLD INTELLECTUAL PROPERTY ORGANIZATION  
International Bureau

## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification <sup>6</sup> :</b> <b>A61K 31/17</b>	<b>A1</b>	<b>(11) International Publication Number:</b> <b>WO 96/25157</b> <b>(43) International Publication Date:</b> 22 August 1996 (22.08.96)
<b>(21) International Application Number:</b> PCT/US96/02260 <b>(22) International Filing Date:</b> 16 February 1996 (16.02.96) <b>(30) Priority Data:</b> 08/390,260 17 February 1995 (17.02.95) US <b>(60) Parent Application or Grant</b> <b>(63) Related by Continuation</b> US 08/390,260 (CIP) Filed on 17 February 1995 (17.02.95) <b>(71) Applicant (for all designated States except US):</b> SMITHKLINE BEECHAM CORPORATION [US/US]; Corporate Intellectual Property, UW2220, 709 Swedeland Road, P.O. Box 1539, King of Prussia, PA 19406-0939 (US). <b>(72) Inventors; and</b> <b>(75) Inventors/Applicants (for US only):</b> WIDDOWSON, Katherine, Louisa [CA/US]; 1047 Old Valley Forge Road, King of Prussia, PA 19406 (US). VEBER, Daniel, Frank [US/US]; 290 Batleson Road, Ambler, PA 19002 (US). JUREWICZ, Anthony, Joseph [US/US]; 523 Fruit Farm Road, Royersford, PA 19468 (US). RUTLEDGE, Melvin, Clarence, Jr. [US/US]; 2148 Schultz Road, Lansdale, PA 19446 (US).	<b>HERTZBERG, Robert, Philip [US/US];</b> 121 Longfields Way, Downingtown, PA 19335 (US). <b>(74) Agents:</b> DINNER, Dara, L. et al.; SmithKline Beecham Corporation, Corporate Intellectual Property, UW2220, 709 Swedeland Road, P.O. Box 1539, King of Prussia, PA 19406-0939 (US). <b>(81) Designated States:</b> JP, US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). <b>Published</b> <i>With international search report.</i> <i>With amended claims.</i>	
<b>(54) Title:</b> IL-8 RECEPTOR ANTAGONISTS <b>(57) Abstract</b> This invention relates to the novel use of phenyl ureas in the treatment of disease states mediated by the chemokine, Interleukin-8 (IL-8).		

**FOR THE PURPOSES OF INFORMATION ONLY**

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AM	Armenia	GB	United Kingdom	MW	Malawi
AT	Austria	GE	Georgia	MX	Mexico
AU	Australia	GN	Guinea	NE	Niger
BB	Barbados	GR	Greece	NL	Netherlands
BE	Belgium	HU	Hungary	NO	Norway
BF	Burkina Faso	IE	Ireland	NZ	New Zealand
BG	Bulgaria	IT	Italy	PL	Poland
BJ	Benin	JP	Japan	PT	Portugal
BR	Brazil	KE	Kenya	RO	Romania
BY	Belarus	KG	Kyrgyzstan	RU	Russian Federation
CA	Canada	KP	Democratic People's Republic of Korea	SD	Sudan
CF	Central African Republic	KR	Republic of Korea	SE	Sweden
CG	Congo	KZ	Kazakhstan	SG	Singapore
CH	Switzerland	LI	Liechtenstein	SI	Slovenia
CI	Côte d'Ivoire	LK	Sri Lanka	SK	Slovakia
CM	Cameroon	LR	Liberia	SN	Senegal
CN	China	LT	Lithuania	SZ	Swaziland
CS	Czechoslovakia	LU	Luxembourg	TD	Chad
CZ	Czech Republic	LV	Latvia	TG	Togo
DE	Germany	MC	Monaco	TJ	Tajikistan
DK	Denmark	MD	Republic of Moldova	TT	Trinidad and Tobago
EE	Estonia	MG	Madagascar	UA	Ukraine
ES	Spain	ML	Mali	UG	Uganda
FI	Finland	MN	Mongolia	US	United States of America
FR	France	MR	Mauritania	UZ	Uzbekistan
GA	Gabon			VN	Viet Nam

## IL-8 RECEPTOR ANTAGONISTS

## FIELD OF THE INVENTION

This invention relates to a novel group of phenyl urea compounds, processes for the preparation thereof, the use thereof in treating IL-8, GRO $\alpha$ , GRO $\beta$ , GRO $\gamma$  and NAP-2 mediated diseases and pharmaceutical compositions for use in such therapy.

## BACKGROUND OF THE INVENTION

Many different names have been applied to Interleukin-8 (IL-8), such as neutrophil attractant/activation protein-1 (NAP-1), monocyte derived neutrophil chemotactic factor (MDNCF), neutrophil activating factor (NAF), and T-cell lymphocyte chemotactic factor.

Interleukin-8 is a chemoattractant for neutrophils, basophils, and a subset of T-cells. It is produced by a majority of nucleated cells including macrophages, fibroblasts, endothelial and epithelial cells exposed to TNF, IL-1 $\alpha$ , IL-1 $\beta$  or LPS, and by neutrophils themselves when exposed to LPS or chemotactic factors such as FMLP. M. Baggiolini et al, J. Clin. Invest. 84, 1045 (1989); J. Schroder et al, J. Immunol. 139, 3474 (1987) and J. Immunol. 144, 2223 (1990); Strieter, et al, Science 243, 1467 (1989) and J. Biol. Chem. 264, 10621 (1989); Cassatella et al, J. Immunol. 148, 3216 (1992).

GRO $\alpha$ , GRO $\beta$ , GRO $\gamma$  and NAP-2 also belong to the chemokine  $\alpha$  family. Like IL-8 these chemokines have also been referred to by different names. For instance GRO $\alpha$ ,  $\beta$ ,  $\gamma$  have been referred to as MGS $\alpha$ ,  $\beta$  and  $\gamma$  respectively (Melanoma Growth Stimulating Activity). see Richmond et al, J. Cell Physiology 129, 375 (1986) and Chang et al, J. Immunol. 148, 451 (1992). All of the chemokines of the  $\alpha$ -family which possess the ELR motif directly preceding the CXC motif bind to the IL-8 B receptor.

IL-8, GRO $\alpha$ , GRO $\beta$ , GRO $\gamma$  and NAP-2 stimulate a number of functions in vitro. They have all been shown to have chemoattractant properties for neutrophils, while IL-8 and GRO $\alpha$  have demonstrated T-lymphocytes, and basophiles chemotactic activity. In addition IL-8 can induce histamine release from basophils from both normal and atopic individuals GRO- $\alpha$  and IL-8 can in addition, induce lysosomal enzyme release and respiratory burst from neutrophils. IL-8 has also been shown to increase the surface expression of Mac-1 (CD11b/CD18) on neutrophils without de novo protein synthesis. This may contribute to increased adhesion of the neutrophils to vascular endothelial cells. Many known diseases are characterized by massive neutrophil infiltration. As IL-8, GRO $\alpha$ , GRO $\beta$ , GRO $\gamma$  and NAP-2 promote the accumulation and activation of neutrophils, these chemokines have been implicated in a wide range of acute and chronic inflammatory disorders including psoriasis and rheumatoid arthritis. Baggiolini et al, FEBS Lett. 307, 97 (1992); Miller et al, Crit. Rev. Immunol. 12, 17 (1992);

Oppenheim et al., Annu. Rev. Immunol. 9, 617 (1991); Seitz et al., J. Clin. Invest. 87, 463 (1991); Miller et al., Am. Rev. Respir. Dis. 146, 427 (1992); Donnelly et al., Lancet 341, 643 (1993). In addition the ELR chemokines (those containing the amino acids ELR motif just prior to the CXC motif) have also been implicated in angiostasis. Strieter et al., Science 258, 1798 (1992).

5 In vitro, IL-8, Gro $\alpha$ , GRO $\beta$ , GRO $\gamma$  and NAP-2 induce neutrophil shape change, chemotaxis, granule release, and respiratory burst, by binding to and activating receptors of the seven-transmembrane, G-protein-linked family, in particular by binding to IL-8 receptors, most notably the B-receptor. Thomas et al., J. Biol. Chem. 266, 14839 (1991); and Holmes  
10 et al., Science 253, 1278 (1991). The development of non-peptide small molecule antagonists for members of this receptor family has precedent. For a review see R. Freidinger in: Progress in Drug Research, Vol. 40, pp. 33-98, Birkhauser Verlag, Basel 1993. Hence, the IL-8 receptor represents a promising target for the development of novel anti-inflammatory agents.

15 Two high affinity human IL-8 receptors (77% homology) have been characterized: IL-8R $\alpha$ , which binds only IL-8 with high affinity, and IL-8R $\beta$ , which has high affinity for IL-8 as well as for GRO- $\alpha$ , GRO $\beta$ , GRO $\gamma$  and NAP-2. See Holmes et al., supra; Murphy et al., Science 253, 1280 (1991); Lee et al., J. Biol. Chem. 267, 16283 (1992); LaRosa et al., J. Biol. Chem. 267, 25402 (1992); and Gayle et al., J. Biol. Chem. 268, 7283 (1993).

20 There remains a need for treatment, in this field, for compounds which are capable of binding to the IL-8  $\alpha$  or  $\beta$  receptor. Therefore, conditions associated with an increase in IL-8 production (which is responsible for chemotaxis of neutrophil and T-cells subsets into the inflammatory site) would benefit by compounds which are inhibitors of IL-8 receptor binding.

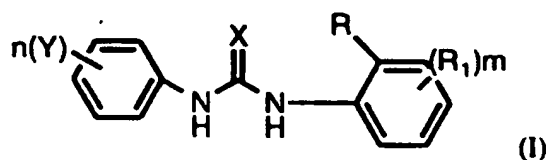
## 25 SUMMARY OF THE INVENTION

This invention provides for a method of treating a chemokine mediated disease, wherein the chemokine is one which binds to an IL-8  $\alpha$  or  $\beta$  receptor and which method comprises administering an effective amount of a compound of Formula (I) or a pharmaceutically acceptable salt thereof. In particular the chemokine is IL-8.

30 This invention also relates to a method of inhibiting the binding of IL-8 to its receptors in a mammal in need thereof which comprises administering to said mammal an effective amount of a compound of Formula (I).

Compounds of Formula (I) useful in the present invention are represented by the structure:

- 3 -



wherein

X is oxygen or sulfur;

R is any functional moiety having an ionizable hydrogen and a pKa of 10 or less;

- 5 R<sub>1</sub> is independently selected from hydrogen; halogen; nitro; cyano; halosubstituted C<sub>1-10</sub> alkyl; C<sub>1-10</sub> alkyl; C<sub>2-10</sub> alkenyl; C<sub>1-10</sub> alkoxy; halosubstituted C<sub>1-10</sub> alkoxy; azide; S(O)<sub>t</sub>R<sub>4</sub>; hydroxy; hydroxy C<sub>1-4</sub>alkyl; aryl; aryl C<sub>1-4</sub> alkyl; aryloxy; aryl C<sub>1-4</sub> alkyloxy; heteroaryl; heteroarylalkyl; heterocyclic, heterocyclic C<sub>1-4</sub>alkyl; heteroaryl C<sub>1-4</sub> alkyloxy; aryl C<sub>2-10</sub> alkenyl; heteroaryl C<sub>2-10</sub> alkenyl; heterocyclic C<sub>2-10</sub> alkenyl; NR<sub>4</sub>R<sub>5</sub>; C<sub>2-10</sub> alkenyl C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>10</sub>; S(O)<sub>3</sub>H; S(O)<sub>3</sub>R<sub>8</sub>; C<sub>1-10</sub> alkyl C(O)R<sub>11</sub>; C<sub>2-10</sub> alkenyl C(O)R<sub>11</sub>; C<sub>2-10</sub> alkenyl C(O)OR<sub>11</sub>; C(O)R<sub>11</sub>; C(O)OR<sub>12</sub>; OC(O) R<sub>11</sub>; NR<sub>4</sub>C(O)R<sub>11</sub>; or two R<sub>1</sub> moieties together may form O-(CH<sub>2</sub>)<sub>5</sub>O- or a 5 to 6 membered unsaturated ring;

t is 0, or an integer having a value of 1 or 2;

- 15 s is an integer having a value of 1 to 3;

R<sub>4</sub> and R<sub>5</sub> are independently hydrogen, optionally substituted C<sub>1-4</sub> alkyl, optionally substituted aryl, optionally substituted aryl C<sub>1-4</sub>alkyl, optionally substituted heteroaryl, optionally substituted heteroaryl C<sub>1-4</sub>alkyl, heterocyclic, heterocyclic C<sub>1-4</sub> alkyl, or R<sub>4</sub> and R<sub>5</sub> together with the nitrogen to which they are attached form a 5 to 7 member ring

- 20 which may optionally comprise an additional heteroatom selected from O/N/S;

Y is independently selected from hydrogen; halogen; nitro; cyano; halosubstituted C<sub>1-10</sub> alkyl; C<sub>1-10</sub> alkyl; C<sub>2-10</sub> alkenyl; C<sub>1-10</sub> alkoxy; halosubstituted C<sub>1-10</sub> alkoxy; azide; S(O)<sub>t</sub>R<sub>4</sub>; hydroxy; hydroxyC<sub>1-4</sub>alkyl; aryl; aryl C<sub>1-4</sub> alkyl; aryloxy; arylC<sub>1-4</sub> alkyloxy; heteroaryl; heteroarylalkyl; heteroaryl C<sub>1-4</sub> alkyloxy; heterocyclic, heterocyclic C<sub>1-4</sub>alkyl; aryl C<sub>2-10</sub> alkenyl; heteroaryl C<sub>2-10</sub> alkenyl; heterocyclic C<sub>2-10</sub> alkenyl; NR<sub>4</sub>R<sub>5</sub>; C<sub>2-10</sub> alkenyl C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>10</sub>; S(O)<sub>3</sub>H; S(O)<sub>3</sub>R<sub>8</sub>; C<sub>1-10</sub> alkyl C(O)R<sub>11</sub>; C<sub>2-10</sub> alkenyl C(O)R<sub>11</sub>; C<sub>2-10</sub> alkenyl C(O)OR<sub>11</sub>; C(O)R<sub>11</sub>; C(O)OR<sub>12</sub>; OC(O) R<sub>11</sub>; NR<sub>4</sub>C(O)R<sub>11</sub>; or two Y moieties together may form O-(CH<sub>2</sub>)<sub>5</sub>O- or a 5 to 6 membered unsaturated ring;

- 30 n is an integer having a value of 1 to 3;

m is an integer having a value of 1 to 3;

R<sub>8</sub> is hydrogen or C<sub>1-4</sub> alkyl;

R<sub>10</sub> is C<sub>1-10</sub> alkyl C(O)<sub>2</sub>R<sub>8</sub>;

R<sub>11</sub> is hydrogen, C<sub>1-4</sub> alkyl, optionally substituted aryl, optionally substituted aryl C<sub>1-4</sub>alkyl, optionally substituted heteroaryl, optionally substituted heteroarylC<sub>1-4</sub>alkyl, optionally substituted heterocyclic, or optionally substituted heterocyclicC<sub>1-4</sub>alkyl;

R<sub>12</sub> is hydrogen, C<sub>1-10</sub> alkyl, optionally substituted aryl or optionally substituted arylalkyl;  
 5 or a pharmaceutically acceptable salt thereof.

Another aspect of the present invention is to a method of treating a chemokine mediated disease, wherein the chemokine is one which binds to an IL-8  $\alpha$  or  $\beta$  receptor and which method comprises administering an effective amount of a compound of Formula (II) or a  
 10 pharmaceutically acceptable salt thereof, as defined herein.

This invention also relates to a method of inhibiting the binding of IL-8 to its receptors in a mammal in need thereof which comprises administering to said mammal an effective amount of a compound of Formula (II), as defined herein.

This invention also relates to the novel compounds of Formula (II), or a  
 15 pharmaceutically acceptable salt thereof, as defined herein.

Another aspect of the present invention is to a method of treating a chemokine mediated disease, wherein the chemokine is one which binds to an IL-8  $\alpha$  or  $\beta$  receptor and which method comprises administering an effective amount of a compound of Formula (III) or a pharmaceutically acceptable salt thereof, as defined herein.

This invention also relates to a method of inhibiting the binding of IL-8 to its receptors in a mammal in need thereof which comprises administering to said mammal an effective amount of a compound of Formula (III), as defined herein.

This invention also relates to the novel compounds of Formula (III), or a pharmaceutically acceptable salt thereof, as defined herein.

25

#### DETAILED DESCRIPTION OF THE INVENTION

The compounds of Formula (I) may also be used in association with the veterinary treatment of mammals, other than humans, in need of inhibition of IL-8 or other chemokines which bind to the IL-8  $\alpha$  and  $\beta$  receptors. Chemokine mediated diseases for treatment,  
 30 therapeutically or prophylactically, in animals include disease states such as those noted herein in the Methods of Treatment section.

In compounds of Formula (I), R is suitably any functional moiety which provides an ionizable hydrogen having a pK<sub>a</sub> of 10 or less, preferably from about 3 to 9, more preferably from about 3 to 7. Such functional groups include, but are not limited to, hydroxy, carboxylic acid, thiol, -SR<sub>2</sub>, -OR<sub>2</sub>, -NH-C(O)R<sub>a</sub>, -C(O)NR<sub>6</sub>R<sub>7</sub>, a substituted sulfonamides of the formula -NHS(O)<sub>2</sub>R<sub>b</sub>, -S(O)<sub>2</sub>NHR<sub>c</sub>, NHC(X<sub>2</sub>)NHR<sub>b</sub>, or a tetrazolyl; wherein X<sub>2</sub> is oxygen or sulfur, preferably oxygen. Preferably, the functional group is other than a sulfonic acid.

35

either directly or as a substituent group on the aryl, heteroaryl, or heterocyclic moiety ring, such as in SR<sub>2</sub> or OR<sub>2</sub>. More preferably R is OH, SH, or NHS(O)<sub>2</sub>R<sub>b</sub>. Suitably, R<sub>2</sub> is a substituted aryl, heteroaryl, or heterocyclic moiety which ring has the functional moiety providing the ionizable hydrogen having a pK<sub>a</sub> of 10 or less.

5

Suitably, R<sub>6</sub> and R<sub>7</sub> are independently hydrogen or a C<sub>1-4</sub> alkyl group, or R<sub>6</sub> and R<sub>7</sub> together with the nitrogen to which they are attached form a 5 to 7 member ring which ring may optionally contain an additional heteroatom which heteroatom is selected from oxygen, nitrogen, or sulfur. This heteroring may be optionally substituted as defined herein.

10

Suitably R<sub>a</sub> is an alkyl, aryl, arylC<sub>1-4</sub>alkyl, heteroaryl, heteroarylC<sub>1-4</sub>alkyl, heterocyclic, or a heterocyclic C<sub>1-4</sub>alkyl moiety, all of which may be optionally substituted, as defined herein below.

15

Suitably, R<sub>b</sub> is a NR<sub>6</sub>R<sub>7</sub>, alkyl, aryl, arylC<sub>1-4</sub>alkyl, arylC<sub>2-4</sub>alkenyl, heteroaryl, heteroarylC<sub>1-4</sub>alkyl, heteroarylC<sub>2-4</sub>alkenyl, heterocyclic, or heterocyclic C<sub>1-4</sub>alkyl, or a heterocyclic C<sub>2-4</sub>alkenyl moiety, camphor, all of which may be optionally substituted one to three times independently by halogen; nitro; halosubstituted C<sub>1-4</sub>alkyl, such as CF<sub>3</sub>; C<sub>1-4</sub>alkyl, such as methyl; C<sub>1-4</sub>alkoxy, such as methoxy; NR<sub>9</sub>C(O)R<sub>a</sub>; C(O)NR<sub>6</sub>R<sub>7</sub>; S(O)<sub>3</sub>H, or C(O)OC<sub>1-4</sub>alkyl. R<sub>b</sub> is preferably an optionally substituted phenyl, benzyl, or styryl. When R<sub>b</sub> is a heteroaryl preferably it is an optionally substituted thiazole, optionally substituted thienyl, or optionally substituted quinoliny ring. Wherein R<sub>9</sub> is hydrogen or a C<sub>1-4</sub>alkyl, preferably hydrogen, and suitably when the substituent group is NR<sub>9</sub>C(O)R<sub>a</sub>, then R<sub>a</sub> is preferably an alkyl group, such as methyl.

20

25

Suitably R<sub>c</sub> is hydrogen, alkyl, aryl, arylC<sub>1-4</sub>alkyl, arylC<sub>1-4</sub>alkenyl, heteroaryl, heteroarylC<sub>1-4</sub>alkyl, heteroarylC<sub>1-4</sub>alkenyl, heterocyclic, or heterocyclic C<sub>1-4</sub>alkyl, or a heterocyclic C<sub>1-4</sub>alkenyl moiety, all of which may be optionally substituted one to three times independently by halogen, nitro, halosubstituted C<sub>1-4</sub>alkyl, C<sub>1-4</sub>alkyl, C<sub>1-4</sub>alkoxy, NR<sub>9</sub>C(O)R<sub>a</sub>, C(O)NR<sub>6</sub>R<sub>7</sub>, S(O)<sub>3</sub>H, or C(O)OC<sub>1-4</sub>alkyl, wherein R<sub>9</sub> is hydrogen or a C<sub>1-4</sub>alkyl. Preferably, R<sub>c</sub> is an optionally substituted phenyl.

30

35

When R is an OR<sub>2</sub> or SR<sub>2</sub> moiety it is recognized by one of skill in the art that the aryl ring must, therefore, contain the required ionizable hydrogen. The aryl ring may also be additionally substituted, independently, by one to three groups, which groups may also contain an additional ionizable group, and which include but are not limited to, halogen, nitro, halosubstituted C<sub>1-4</sub>alkyl, C<sub>1-4</sub>alkyl, C<sub>1-4</sub>alkoxy, hydroxy, SH, -C(O)NR<sub>6</sub>R<sub>7</sub>, -NH-C(O)R<sub>a</sub>, -NHS(O)<sub>2</sub>R<sub>b</sub>, S(O)<sub>2</sub>NR<sub>6</sub>R<sub>7</sub>, C(O)OR<sub>8</sub>, or a tetrazolyl ring.

In compounds of Formula (I), suitably  $R_1$  is independently selected from hydrogen; halogen; nitro; cyano; halosubstituted  $C_{1-10}$  alkyl, such as  $CF_3$ ;  $C_{1-10}$  alkyl, such as methyl, ethyl, isopropyl, or n-propyl;  $C_{2-10}$  alkenyl;  $C_{1-10}$  alkoxy, such as methoxy, or ethoxy; halosubstituted  $C_{1-10}$  alkoxy, such as trifluoromethoxy; azide;  $S(O)_tR_4$ , wherein  $t$  is 0, 1 or 2; hydroxy; hydroxy  $C_{1-4}$  alkyl, such as methanol or ethanol; aryl, such as phenyl or naphthyl; aryl  $C_{1-4}$  alkyl, such as benzyl; aryloxy, such as phenoxy; aryl  $C_{1-4}$  alkyloxy, such as benzyloxy; heteroaryl; heteroarylalkyl; heteroaryl  $C_{1-4}$  alkyloxy; aryl  $C_{2-10}$  alkenyl; heteroaryl  $C_{2-10}$  alkenyl;  $NR_4R_5$ ;  $C_{2-10}$  alkenyl- $C(O)NR_4R_5$ ;  $C(O)NR_4R_5$ ;  $C(O)NR_4R_{10}$ ;  $S(O)_3H$ ;  $S(O)_3R_8$ ;  $C_{1-10}$  alkyl  $C(O)R_{11}$ ;  $C_{2-10}$  alkenyl  $C(O)R_{11}$ ;  $C_{2-10}$  alkenyl  $C(O)OR_{11}$ ;  $C(O)R_{11}$ ;  $C(O)OR_{12}$ , such as carboxy, methylcarboxylate or phenylbenzoate;  $OC(O)R_{11}$ ;  $NR_4C(O)R_{11}$ ; azido; or two  $R_1$  moieties together may form  $O-(CH_2)_sO-$  or a 5 to 6 membered unsaturated ring; and  $s$  is an integer having a value of 1 to 3. The aryl, arylalkyl, arylalkenyl, heteroaryl, heteroarylalkyl, heteroarylalkenyl, heterocyclic, heterocyclicalkyl, and heterocyclicalkenyl moieties may all be optionally substituted as defined herein below. Preferably  $R_1$  is other than azido or  $S(O)_3R_8$ .

When  $R_1$  forms a dioxybridge,  $s$  is preferably 1. When  $R_1$  forms an additional unsaturated ring, it is preferably 6 membered resulting in a naphthylene ring system. This naphthylene ring may be substituted independently, 1 to 3 times by the other  $R_1$  moieties as defined above.

Suitably,  $R_4$  and  $R_5$  are independently hydrogen, optionally substituted  $C_{1-4}$  alkyl, optionally substituted aryl, optionally substituted aryl  $C_{1-4}$  alkyl, optionally substituted heteroaryl, optionally substituted heteroaryl  $C_{1-4}$  alkyl, heterocyclic, heterocyclic  $C_{1-4}$  alkyl, or  $R_4$  and  $R_5$  together with the nitrogen to which they are attached form a 5 to 7 member ring which may optionally comprise an additional heteroatom selected from O/N/S.

$R_{10}$  is suitably  $C_{1-10}$  alkyl  $C(O)_2R_8$ , such as  $CH_2C(O)_2H$  or  $CH_2C(O)_2CH_3$ .

$R_{11}$  is suitably hydrogen,  $C_{1-4}$  alkyl, aryl, aryl  $C_{1-4}$  alkyl, heteroaryl, heteroaryl  $C_{1-4}$  alkyl, heterocyclic, or heterocyclic  $C_{1-4}$  alkyl.

$R_{12}$  is suitably hydrogen,  $C_{1-10}$  alkyl, optionally substituted aryl or optionally substituted arylalkyl.

Preferably  $R_1$  is halogen, cyano, nitro,  $CF_3$ ,  $C(O)NR_4R_5$ , alkenyl  $C(O)NR_4R_5$ ,  $C(O)NR_4R_{10}$ , alkenyl  $C(O)OR_{12}$ , heteroaryl, heteroarylalkyl, heteroaryl alkenyl, or  $S(O)NR_4R_5$ .



- 7 -

and preferably R<sub>4</sub> and R<sub>5</sub> are both hydrogen or one is phenyl. A preferred ring substitution for R<sub>1</sub> is in the 4-position of the phenyl ring.

When R is OH, SH or NSO<sub>2</sub>R<sub>h</sub>, than R<sub>1</sub> is preferably substituted in the 3-position, the  
 5 4- position or di substituted in the 3,4- position. The substituent group is suitably an electron withdrawing moiety. Preferably when R is OH, SH or NSO<sub>2</sub>R<sub>h</sub>, than R<sub>1</sub> is nitro, halogen, cyano, trifluoromethyl group, C(O)NR<sub>4</sub>R<sub>5</sub>.

When R is carboxylic acid, than R<sub>1</sub> is preferably hydrogen, or R<sub>1</sub> is preferably  
 10 substituted in the 4-position, more preferably substituted by trifluoromethyl or chloro.

In compounds of Formula (I), suitably Y is independently selected from hydrogen:  
 halogen; nitro; cyano; halosubstituted C<sub>1-10</sub> alkyl; C<sub>1-10</sub> alkyl; C<sub>2-10</sub> alkenyl; C<sub>1-10</sub> alkoxy;  
 halosubstituted C<sub>1-10</sub> alkoxy; azide; S(O)<sub>1</sub>R<sub>4</sub>; hydroxy; hydroxy C<sub>1-4</sub>alkyl; aryl; aryl C<sub>1-4</sub>  
 15 alkyl; aryloxy; arylC<sub>1-4</sub> alkyloxy; aryl C<sub>2-10</sub> alkenyl; heteroaryl; heteroarylalkyl; heteroaryl  
 C<sub>1-4</sub> alkyloxy; heteroaryl C<sub>2-10</sub> alkenyl; heterocyclic, heterocyclic C<sub>1-4</sub>alkyl; heterocyclicC<sub>2-10</sub>  
 10 alkenyl; NR<sub>4</sub>R<sub>5</sub>; C<sub>2-10</sub> alkenyl C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>10</sub>; S(O)<sub>3</sub>H;  
 S(O)<sub>3</sub>R<sub>8</sub>; C<sub>1-10</sub> alkyl C(O)R<sub>11</sub>; C<sub>2-10</sub> alkenyl C(O)R<sub>11</sub>; C<sub>2-10</sub> alkenyl C(O)OR<sub>11</sub>;  
 C(O)R<sub>11</sub>; C(O)OR<sub>12</sub>; OC(O) R<sub>11</sub>; NR<sub>4</sub>C(O)R<sub>11</sub>; azido; or two Y moieties together may form  
 20 O-(CH<sub>2</sub>)<sub>5</sub>O- or a 5 to 6 membered unsaturated ring. When Y forms a dioxybridge, s is  
 preferably 1. When Y forms an additional unsaturated ring, it is preferably 6 membered  
 resulting in a naphthylene ring system. This naphthylene ring may be substituted 1 to 3 times  
 by other Y moieties as defined above. The aryl, heteroaryl and heterocyclic moieties noted  
 above may all be optionally substituted as defined herein. Preferably R<sub>1</sub> is other than azido or  
 25 S(O)<sub>3</sub>R<sub>8</sub>.

Y is preferably a halogen, C<sub>1-4</sub> alkoxy, optionally substituted aryl, optionally  
 substituted aryloxy or arylalkoxy, methylene dioxy, NR<sub>4</sub>R<sub>5</sub>, thio C<sub>1-4</sub>alkyl, thioaryl,  
 halosubstituted alkoxy, optionally substituted C<sub>1-4</sub> alkyl, or hydroxy alkyl. Y is more  
 30 preferably mono-substituted halogen, disubstituted halogen, mono-substituted alkoxy,  
 disubstituted alkoxy, methylenedioxy, aryl, or alkyl, more preferably these groups are mono or  
 di-substituted in the 2'- position or 2', 3'-position.

While Y may be substituted in any of the 5 ring positions, preferably when R is OH,  
 35 SH, or NSO<sub>2</sub>R<sub>h</sub>, Y is preferably mono-substituted in the 2'-position or 3'- position, with the  
 4'- preferably being unsubstituted. If the ring is disubstituted, when R is OH, SH, or  
 NSO<sub>2</sub>R<sub>h</sub>, substituents are preferably in the 2' or 3' position of a monocyclic ring. While both

R<sub>1</sub> and Y can both be hydrogen, it is preferred that at least one of the rings be substituted, preferably both rings are substituted.

In compounds of Formula (I), X is suitably oxygen or sulfur, preferably oxygen.

5

While not explicitly covered by Formula (I), (Ia-c), (II), or (III), another aspect of this invention are the symmetrical bis compounds which are included for each structure.

Compounds exemplified by this bis like structure include:

- 10 N-(Bis (2-hydroxy-4-nitro phenyl) N'-(dianisidine) diurea  
4-Methylene bis(N-(2-chloro phenyl) N'-(2-hydroxy 4-nitro phenyl) urea)

Exemplified compounds of Formula (I) include:

- N-[2-Hydroxy-4-(methoxycarbonyl)phenyl]-N'-phenylurea:  
15 N-[5-Nitro-2-hydroxyphenyl]-N'-phenyl urea  
3-Hydroxy-4-[(phenylamino)carbonyl]amino benzamide  
N-(2-Hydroxy-4-fluorophenyl)-N'-phenyl urea  
2-[(Phenylamino)carbonyl]amino thiophenol  
N-(2-Carboxy-4-hydroxyphenyl)-N'-phenyl urea  
20 N-[2-Hydroxy-4-(trifluoromethyl)phenyl]-N'-phenyl urea  
N-(2-Hydroxy-4-nitrophenyl)-N'-(2-hydroxy-4-nitrophenyl) urea  
N-(2-Hydroxy-4-nitrophenyl)-N'-phenyl-thiourea  
N-(4-Nitro-2-(phenylsulfonylamino)phenyl)-N'-phenyl urea  
N-(2-Hydroxy-5-nitrophenyl)-N'-(3-methoxy-2-thienyl)urea  
25 N-(2-Hydroxy-4-nitrophenyl)-N'-(3-methoxy-2-thienyl)urea  
N-(2-Hydroxy-4-nitrophenyl)-N'-(3-methoxyphenyl)urea  
N-(2-Hydroxy-4-nitrophenyl)-N'-(2-methoxyphenyl)urea  
N-(2-Hydroxy-4-nitrophenyl)-N'-(3-trifluoromethylphenyl)urea  
N-(2-Hydroxy-4-nitrophenyl)-N'-(2-trifluoromethylphenyl)urea  
30 N-(2-Hydroxy-4-nitrophenyl)-N'-(4-trifluoromethylphenyl)urea  
N-(2-Hydroxy-4-nitrophenyl)-N'-(2-bromophenyl)urea  
N-(2-Hydroxy-4-nitrophenyl)-N'-(3-bromophenyl)urea  
N-(2-Hydroxy-4-nitrophenyl)-N'-(4-bromophenyl)urea  
N-(2-Hydroxy-4-nitrophenyl)-N'-(2-phenylphenyl)urea  
35 N-(2-Hydroxy-4-nitrophenyl)-N'-(1-naphthyl)urea:  
N-(2-Hydroxy-4-nitrophenyl)-N'-(2-nitrophenyl)urea  
N-(2-Hydroxy-4-nitrophenyl)-N'-(2-fluorophenyl)urea  
N-(2-Hydroxy-4-nitrophenyl)-N'-(2,6-difluorophenyl)urea

- N-(2-Hydroxy-4-nitrophenyl)-N'-(2-ethoxyphenyl)urea  
N-(2-Hydroxy-4-nitrophenyl)-N'-(2-ethylphenyl)urea  
N-(2-Hydroxy-4-nitrophenyl)-N'-(2-trifluoromethoxyphenyl)urea  
N-(2-Hydroxy-4-nitrophenyl) N'-(2-methylthiophenyl) urea  
5 N-(2-Hydroxy-4-nitrophenyl) N'-(2-chloro 6-methyl phenyl) urea  
N-(2-Hydroxy-4-nitrophenyl) N'-(2-sulfoxymethyl phenyl) urea  
N-(4-Trifluoromethyl-2-hydroxy phenyl) N'-(2-bromo phenyl) urea  
N-(4-Carbomethoxy 2-hydroxy phenyl) N'-(2-bromophenyl) urea  
N-(4-Trifluoromethyl-2-hydroxy phenyl) N'-(2-phenyl phenyl) urea  
10 N-(4-Carbomethoxy 2-hydroxy phenyl) N'-(2-phenyl phenyl) urea  
N-(2-Hydroxy-4-nitrophenyl) N'-(2,3-dichloro phenyl) urea  
N-(2-Hydroxy-4-nitrophenyl) N'-(2,4-dichloro phenyl) urea  
N-(2-Hydroxy-4-nitrophenyl) N'-(2-chloro phenyl) urea  
N-(2-Hydroxy-4-nitrophenyl) N'-(2,4-dibromo phenyl) urea  
15 N-(2-Hydroxy-1-naphthyl)-N'-(2-bromo phenyl) urea  
N-(2-Hydroxy-4-nitrophenyl)-N'-(2,3-methylenedioxyphenyl)urea  
N-(2-Hydroxy-4-nitrophenyl) N'-(3-chloro 2-methoxy phenyl) urea  
N-(2-Hydroxy-4-nitrophenyl) N'-(2-methyl phenyl) urea  
N-[4-(Benzylamino)carbonyl-2-hydroxyphenyl]-N'-(2-bromophenyl)urea  
20 N-(2-Hydroxy-4-nitrophenyl)-N'-(2-phenoxy phenyl) urea  
N-(2-Hydroxy-4-fluoro phenyl)-N'-(2-bromo phenyl) urea  
N-(2-Hydroxy 3-naphthyl) N'-(2-bromo phenyl) urea;  
N-(3,4-Difluoro 2-hydroxy phenyl) N'-(2-bromo phenyl) urea  
N-(2-Hydroxy 4-phenyl phenyl) N'-(2-bromo phenyl) urea  
25 N-(2-Hydroxy 4-methyl phenyl) N'-(2-bromo phenyl) urea  
N-(2-Hydroxy-4-nitro phenyl) N'-(2-phenylamino phenyl) urea  
N-(2-Hydroxy 3-carboxyphenyl) N'-(2-bromo phenyl) urea  
N-(2-Sulphydryl 4-bromo phenyl) N'-(2-bromo phenyl) urea  
N-(2-Hydroxy 4-nitro phenyl) N'-(2-iodo phenyl) urea  
30 N-(2-Hydroxy 4-nitro phenyl) N'-(2-bromo phenyl) thiourea  
N-[(2-Phenylsulfamido) 4-cyanophenyl]- N'-(2-bromo phenyl) urea  
N-(2-(Amino sulfonamido phenyl) phenyl) N'-(2-bromo phenyl) urea  
N-(2-(Amino sulfonyl styryl) phenyl) N'-(2-bromo phenyl) urea  
2-[(3,4 Di-methoxyphenylsulfonyl)amino] phenyl) N'-(2-bromo phenyl) urea  
35 N-(2-[(4-Acetamidophenylsulfonyl)amino] phenyl) N'-(2-bromo phenyl) urea  
N-(2-(Amino sulfonyl (2-thiophene) phenyl) N'-(2-bromo phenyl) urea  
N-(2-(Amino sulfonyl (3-tolyl) phenyl) N'-(2-bromo phenyl) urea  
N-(2-(Amino sulfonyl (8-quinoliny)) phenyl) N'-(2-bromo phenyl) urea

- N-(2-(Amino sulfonyl benzyl) phenyl) N'-(2-bromo phenyl) urea  
 N-(2-Hydroxy-4-azidophenyl)-N'-(2-methoxyphenyl)urea  
 N-[2-Hydroxy-5-cyanophenyl]-N'-[2-bromophenyl] urea  
 N-[2-Hydroxy-3-fluorophenyl]-N'-[2-bromophenyl] urea  
 5 N-[2-Hydroxy-3-fluoro-5-bromophenyl]-N'-[2-bromophenyl] urea  
 N-[2-Hydroxy-3-chlorophenyl]-N'-[2-bromophenyl] urea  
 N-[2-Hydroxy-3-trifluoromethylphenyl]-N'-[2-bromophenyl] urea  
 N-[2-Hydroxy-3,4-diphenyl-phenyl]-N'-[2-bromophenyl] urea  
 N-[2-Hydroxy-3-glycinemethylestercarbonylphenyl]-N'-[2-bromophenyl] urea  
 10 N-[2-Hydroxy-3-glycincarbonylphenyl]-N'-[2-bromophenyl] urea  
 N-[2-Hydroxy-3,5-dichlorophenyl]-N'-[2-bromophenyl] urea  
 N-[2-Hydroxy-3-nitrophenyl]-N'-[2-bromophenyl] urea  
 N-[2-Hydroxy-3,4-dichlorophenyl]-N'-[2-bromophenyl] urea  
 N-[2-Hydroxy-3-cyanophenyl]-N'-[2-bromophenyl] urea  
 15 N-[2-Hydroxy-4-cyanophenyl]-N'-[2-bromophenyl] urea  
 N-[2-Hydroxy-4-cyanophenyl]-N'-[4-methoxyphenyl] urea  
 N-[2-Hydroxy-4-cyanophenyl]-N'-[2-phenylphenyl] urea  
 N-[2-Hydroxy-4-cyanophenyl]-N'-[2-methylphenyl] urea  
 N-[2-Hydroxy-4-cyanophenyl]-N'-[2-trifluoromethylphenyl] urea  
 20 N-[2-Hydroxy-4-cyanophenyl]-N'-[3-trifluoromethylphenyl] urea  
 N-[2-Hydroxy-4-cyanophenyl]-N'-[4-trifluoromethylphenyl] urea  
 N-[2-Hydroxy-3-n-propylphenyl]-N'-[2-bromophenyl] urea  
 N-[2-Hydroxy-4-ethylphenyl]-N'-[2-bromophenyl] urea  
 N-[2-Hydroxy-3-phenylaminocarbonyl phenyl]-N'-[2-bromophenyl] urea  
 25 N-[2-Hydroxy-3-cyano-4-methylphenyl]-N'-[2-bromophenyl] urea  
 N-[2-Hydroxy-4-carbophenyl phenyl]-N'-[2-bromophenyl] urea  
 N-[2-Hydroxy-3-carbophenyl phenyl]-N'-[2-bromophenyl] urea  
 N-[3-Benzoyloxy-2-hydroxyphenyl]-N'-[2-bromophenyl] urea  
 (E)-N-[4-[2-(Methoxycarbonyl) ethenyl]-2-hydroxyphenyl]-N'-[2-bromophenyl] urea  
 30 (E)-N-[3-[2-(Methoxycarbonyl) ethenyl]-2-hydroxyphenyl]-N'-[2-bromophenyl] urea-N'-[2-bromophenyl] urea  
 (E)-N-[3-[2-(Aminocarbonyl) ethenyl]-2-hydroxyphenyl]-N'-[2-bromophenyl]urea-N'-[2-bromophenyl] urea  
 (E)-N-[4-[2-(Aminocarbonyl) ethenyl]-2-hydroxyphenyl]-N'-[2-bromophenyl]urea-N'-[2-bromophenyl] urea  
 35 N-[2-Hydroxy-4-benzamide phenyl]-N'-[2-bromophenyl] urea  
 N-[4-Aminocarbonyl-2-hydroxyphenyl]-N'-[2-bromophenyl] urea  
 N-(2-Hydroxy-3,5,6-trifluorophenyl)-N'-(2-bromophenyl)urea

- N-(2-Hydroxy-3-fluoro-4-trifluoromethylphenyl)-N'-(2-bromophenyl)urea  
 N-(2-Hydroxy-3-iodophenyl)-N'-(2-bromophenyl)urea  
 N-[2-[[[2-(Trifluoromethyl)phenyl]sulfonylamino]phenyl]-N'-(2-bromophenyl)urea  
 N-(2-Bromophenyl)-N'-[2-dimethylaminosulfonylamino]phenyl]urea  
 5 N-[2-(Phenethylsulfonylamino)phenyl]-N'-(2-bromophenyl)urea  
 N-[2-[(2-Acetamido-4-methylthiazol-5-yl)sulfonylamino]phenyl]-N'-(2-bromophenyl)urea  
 N-[2-Hydroxy-4-cyanophenyl]-N'-[4-phenylphenyl] urea  
 N-[2-Hydroxy-4-cyanophenyl]-N'-[2,3-dichlorophenyl] urea  
 N-[2-Hydroxy-4-cyanophenyl]-N'-[2-methoxyphenyl] urea  
 10 N-[2-Hydroxy-4-cyanophenyl]-N'-[3-methoxyphenyl] urea  
 N-[2-Hydroxy-5-fluorophenyl]-N'-(2-bromophenyl) urea  
 N-[2-Hydroxy-5-trifluoromethylphenyl]-N'-(2-bromophenyl) urea  
 N-[2-Hydroxyphenyl]-N'-(2-bromophenyl) urea  
 N-[Trans-3-styryl-2-hydroxyphenyl]-N'-(2-bromophenyl) urea  
 15 N-[2-Hydroxy-3,4-dichlorophenyl]-N'-(2-methoxyphenyl) urea  
 N-[2-Hydroxy-3,4-dichlorophenyl]-N'-[4-methoxyphenyl] urea  
 N-[2-Hydroxy-3,4-dichlorophenyl]-N'-[3-trifluoromethylphenyl] urea  
 N-[2-Hydroxy-3,4-dichlorophenyl]-N'-[2-phenylphenyl] urea  
 N-[2-Hydroxy-3,4-dichlorophenyl]-N'-[4-phenylphenyl] urea  
 20 N-[2-Hydroxy-3,4-dichlorophenyl]-N'-(2,3-dichlorophenyl) urea  
 N-[2-Hydroxy-4-isopropylphenyl]-N'-(3-trifluoromethylphenyl) urea  
 N-[2-Hydroxy-3-naphthyl]-N'-(2,3-dichlorophenyl) urea  
 N-[2-[(2,3-Dichlorothien-5-yl)sulfonylamino]phenyl]-N'-(2-bromophenyl)urea  
 N-[2-[(3,5-Bis(trifluoromethyl)phenyl)sulfonylamino]phenyl]-N'-(2-bromophenyl)urea  
 25 N-[2-[(2-Benzyl)sulfonylamino]-(5-trifluoromethyl)phenyl]-N'-(2-bromophenyl)urea  
 N-[2-[2-(3-Nitrophenyl)sulfonylamino]phenyl]-N'-(2-bromophenyl)urea  
  
 N-[2-[2-(4-Phenoxyphenyl)sulfonylamino]phenyl]-N'-(2-bromophenyl) urea  
 N-[2-(1S)-10-Camphorsulfonylamino]phenyl]-N'-(2-bromophenyl)urea  
 30 N-[2-(1R)-10-Camphorsulfonylamino]phenyl]-N'-(2-bromophenyl)urea  
 N-[2-[2-(2-Nitro-(4-trifluoromethyl)phenyl)sulfonylamino]phenyl]-N'-(2-bromophenyl)urea  
 N-(2-Hydroxy-4-azidophenyl)-N'-(2-iodophenyl)urea  
 N-(2-Hydroxy-3-azidophenyl)-N'-(2-bromophenyl)urea  
 N-[2-Hydroxy-3-cyanophenyl]-N'-[2-methoxyphenyl] urea  
 35 N-[2-Hydroxy-3-cyanophenyl]-N'-[3-trifluoromethylphenyl] urea  
 N-[2-Hydroxy-3-cyanophenyl]-N'-[2-phenylphenyl] urea  
 N-[2-Hydroxy-3-cyanophenyl]-N'-[2,3-dichlorophenyl] urea  
 N-[2-Hydroxy-4-isopropylphenyl]-N'-(2,3-dichlorophenyl) urea

- N-[2-Hydroxy-4-isopropylphenyl]-N'-[2-chloro-5-trifluoromethylphenyl] urea  
 N-[2-Hydroxy-3-phenylphenyl]-N'-[2,3-dichlorophenyl] urea  
 N-[2-Hydroxy-5-nitrophenyl]-N'-[2-methoxyphenyl] urea  
 N-[2-Hydroxy-5-nitrophenyl]-N'-[3-trifluoromethylphenyl] urea  
 5 N-[2-Hydroxy-5-nitrophenyl]-N'-[2-phenylphenyl] urea  
 N-[2-Hydroxy-5-nitrophenyl]-N'-[2,3-dichlorophenyl] urea  
 N-[2-Hydroxy-5-ethylsulfonylphenyl]-N'-[2,3-dichlorophenyl] urea  
 N-[2-(2-Amino-(4-trifluoromethyl) phenyl) sulfonylamino] phenyl]- N'-(2-bromophenyl)urea  
 10 N-[2-(Aminosulfonyl phenyl) 3-amino phenyl] N'-(2-bromo phenyl) urea  
 N-[2-Hydroxy-3,4-dichlorophenyl]-N'-[2,4 dimethoxyphenyl] urea  
 N-[2-Hydroxy-3,4-dichlorophenyl]-N'-[2-chloro-5-trifluoromethylphenyl] urea  
 N-[2-Hydroxy-3-naphthyl]-N'-[3-trifluoromethylphenyl] urea  
 N-[2-Hydroxy-5-naphthalenesulfonic acid]-N'-[2-bromophenyl] urea:  
 15 N-[2-Hydroxy-4-naphthalenesulfonic acid]-N'-[2-bromophenyl] urea:  
 1,1'-(4-Methyl-2-phenylene)bis[2-thio-3-3-tolylurea]  
 N-(2-Carboxyphenyl)-N'-phenylurea  
 N-(2-Hydroxy-4-nitrophenyl)-N'-phenylurea:  
 1-(2-Carboxyphenyl)-3-(4-chlorophenyl)urea :  
 20 2-(3,4-Dichlorophenylcarbonyldiimino)-5-trifluoromethylbenzoic acid:  
 2-(4-Chlorophenylcarbonyldiimino)-5-trifluoromethylbenzoic acid:  
 1-(p-Anisyl)-3-(2-carboxyphenyl)urea:  
 1-(2-Carboxyphenyl)-3-(3-fluorophenyl)urea:  
 1-(2-Carboxyphenyl)-3-(3-chlorophenyl)urea:  
 25 1-(m-Anisyl)-3-(2-carboxyphenyl)urea:  
 1-(o-Anisyl)-3-(2-carboxyphenyl)urea :  
 1-(2-Carboxyphenyl)-3-(3,4-dichlorophenyl)urea:  
 1-(2-Carboxyphenyl)-3-(2,4-dichlorophenyl)urea:  
 N-(5-Chloro-2-hydroxy-4-nitrophenyl)-N'-phenylurea:  
 30 N-(2-Hydroxy-4-nitrophenyl)-N'-(4-nitrophenyl)urea:

Preferred compounds of Formula (I) include:

- N-(2-Hydroxy-4-nitrophenyl)-N'-(2-methoxyphenyl)urea  
 N-(2-Hydroxy-4-nitrophenyl)-N'-(2-bromophenyl)urea  
 35 N-(2-Hydroxy-4-nitrophenyl)-N'-(2-phenylphenyl)urea  
 N-(2-Hydroxy-4-nitrophenyl)-N'-(2-methylthiophenyl)urea  
 N-(2-Hydroxy-4-nitrophenyl)-N'-(2,3-dichlorophenyl)urea  
 N-(2-hydroxy 4-nitro phenyl) N'-(2-chloro phenyl) urea

- N-(2-Hydroxy-4-nitrophenyl)-N'-(2,3-methylenedioxyphenyl)urea  
 N-(2-Hydroxy-4-nitrophenyl)-N'-(2-methoxy-3-chlorophenyl)urea  
 N-(2-hydroxy 4-nitro phenyl) N'-(2-phenyloxy phenyl) urea  
 N-(3-Chloro-2-hydroxyphenyl)-N'-(bromophenyl)urea  
 5 N-(2-Hydroxy-3-glycinemethylestercarbonylphenyl)-N'-(2-bromophenyl)urea  
 N-(3-Nitro-2-hydroxyphenyl)-N'-(2-bromophenyl)urea  
 N-(2-Hydroxy-4-cyanophenyl)-N'-(2-bromophenyl)urea  
 N-(2-Hydroxy-3,4-dichlorophenyl)-N'-(2-bromophenyl)urea  
 N-(3-Cyano-2-hydroxyphenyl)-N'-(2-bromophenyl)urea  
 10 N-(2-Hydroxy-4-cyanophenyl)-N'-(2-methoxyphenyl)urea  
 N-(2-Hydroxy-4-cyanophenyl)-N'-(2-phenylphenyl)urea  
 N-(2-Hydroxy-4-cyanophenyl)-N'-(2,3-dichlorophenyl)urea  
 N-(2-Hydroxy-4-cyanophenyl)-N'-(2-methylphenyl)urea  
 N-(2-Hydroxy-3-cyano-4-methylphenyl)-N'-(2-bromophenyl)urea  
 15 N-(4-Cyano-2-hydroxyphenyl)-N'-(2-trifluoromethylphenyl)urea  
 N-(3-Trifluoromethyl-2-hydroxyphenyl)-N'-(2-bromophenyl)urea  
 N-(3-Phenylaminocarbonyl-2-hydroxyphenyl)-N'-(2-bromophenyl)urea  
 N-(2-hydroxy 4-nitro phenyl) N'-(2-iodo phenyl) urea  
 N-(2-hydroxy 4-nitro phenyl) N'(2-bromo phenyl) thiourea  
 20 N-(2-phenylsulfonamido)-4-cyanophenyl-N'(2-bromo phenyl)urea  
 (E)-N-[3-[(2-Aminocarbonyl)ethenyl]-2-hydroxyphenyl]-N'-(2-bromophenyl)urea  
 N-(2-Hydroxy-3,4-dichlorophenyl)-N'-(2-methoxyphenyl)urea  
 N-(2-Hydroxy-3,4-dichlorophenyl)-N'-(2-phenylphenyl)urea  
 N-(2-Hydroxy-3,4-dichlorophenyl)-N'-(2,3-dichlorophenyl)urea  
 25 N-(2-Hydroxy-5-nitrophenyl)-N'-(2,3-dichlorophenyl)urea  
 N-(2-Hydroxy-3-cyanophenyl)-N'-(2,3 dichlorophenyl)urea

- As used herein, "optionally substituted" unless specifically defined shall mean such groups as halogen, such as fluorine, chlorine, bromine or iodine; hydroxy; hydroxy substituted  
 30 C<sub>1-10</sub>alkyl; C<sub>1-10</sub>alkoxy, such as methoxy or ethoxy; S(O)<sub>m</sub> C<sub>1-10</sub> alkyl, wherein m is 0, 1 or 2, such as methyl thio, methyl sulfinyl or methyl sulfonyl; amino, mono & di-substituted amino, such as in the NR<sub>4</sub>R<sub>5</sub> group; NHC(O)R<sub>4</sub>; C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)OH; S(O)<sub>2</sub>NR<sub>4</sub>R<sub>5</sub>; NHS(O)<sub>2</sub>R<sub>13</sub>; C<sub>1-10</sub> alkyl, such as methyl, ethyl, propyl, isopropyl, or t-butyl; halosubstituted C<sub>1-10</sub> alkyl, such CF<sub>3</sub>; an optionally substituted aryl, such as phenyl, or an  
 35 optionally substituted arylalkyl, such as benzyl or phenethyl, optionally substituted heterocyclic, optionally substituted heterocyclicalkyl, optionally substituted heteroaryl, optionally substituted heteroaryl alkyl, wherein these aryl, heteroaryl, or heterocyclic moieties may be substituted one to two times by halogen; hydroxy; hydroxy substituted alkyl; C<sub>1-10</sub> alkoxy; S(O)<sub>m</sub>C<sub>1-10</sub>

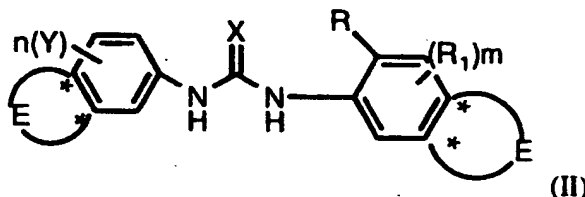
- 14 -

alkyl; amino, mono & di-substituted amino, such as in the  $\text{NR}_4\text{R}_5$  group;  $\text{C}_{1-10}$  alkyl, or halosubstituted  $\text{C}_{1-10}$  alkyl, such as  $\text{CF}_3$ .

$\text{R}_{13}$  is suitably  $\text{C}_{1-4}$  alkyl, aryl, aryl  $\text{C}_{1-4}$ alkyl, heteroaryl, heteroaryl $\text{C}_{1-4}$ alkyl, heterocyclic, or heterocyclic $\text{C}_{1-4}$ alkyl.

5

Another aspect of the present invention are the novel compounds of Formula (II), or a pharmaceutically acceptable salt thereof, as described below, which are also useful in inhibiting the binding of IL-8 to its receptors in a mammal in need thereof. This invention also relates to the pharmaceutical compositions comprising a compound of Formula (II) and a pharmaceutically acceptable diluent or carrier. Compounds of Formula (II) are also useful for treating a chemokine mediated disease, wherein the chemokine is one which binds to an IL-8  $\alpha$  or  $\beta$  receptor and which method comprises administering an effective amount of a compound of Formula (II) or a pharmaceutically acceptable salt thereof. Compounds of Formula (II) are represented by the structure:



15

wherein

X is oxygen or sulfur;

R is any functional moiety having an ionizable hydrogen and a  $\text{pK}_a$  of 10 or less;

$\text{R}_1$  is independently selected from hydrogen; halogen; nitro; cyano; halosubstituted  $\text{C}_{1-10}$

20 alkyl;  $\text{C}_{1-10}$  alkyl;  $\text{C}_{2-10}$  alkenyl;  $\text{C}_{1-10}$  alkoxy; halosubstituted  $\text{C}_{1-10}$  alkoxy; azide;  $\text{S(O)}_t\text{R}_4$ ; hydroxy; hydroxy $\text{C}_{1-4}$ alkyl; aryl; aryl  $\text{C}_{1-4}$  alkyl; aryloxy; aryl $\text{C}_{1-4}$  alkyloxy; heteroaryl; heteroarylalkyl; heterocyclic, heterocyclic $\text{C}_{1-4}$ alkyl; heteroaryl $\text{C}_{1-4}$  alkyloxy; aryl  $\text{C}_{2-10}$  alkenyl; heteroaryl  $\text{C}_{2-10}$  alkenyl; heterocyclic $\text{C}_{2-10}$  alkenyl;  $\text{NR}_4\text{R}_5$ ;  $\text{C}_{2-10}$  alkenyl  $\text{C(O)NR}_4\text{R}_5$ ;  $\text{C(O)NR}_4\text{R}_5$ ;  $\text{C(O)NR}_4\text{R}_{10}$ ;  $\text{S(O)}_3\text{H}$ ;  $\text{S(O)}_3\text{R}_8$ ;  $\text{C}_{1-10}$  alkyl

25  $\text{C(O)R}_{11}$ ;  $\text{C}_{2-10}$  alkenyl  $\text{C(O)R}_{11}$ ;  $\text{C}_{2-10}$  alkenyl  $\text{C(O)OR}_{11}$ ;  $\text{C(O)R}_{11}$ ;  $\text{C(O)OR}_{12}$ ;  $\text{OC(O)R}_{11}$ ;  $\text{NR}_4\text{C(O)R}_{11}$ ; or two  $\text{R}_1$  moieties together may form  $\text{O-(CH}_2)_5\text{O-}$  or a 5 to 6 membered unsaturated ring;

t is 0, or an integer having a value of 1 or 2;

s is an integer having a value of 1 to 3;

30  $\text{R}_4$  and  $\text{R}_5$  are independently hydrogen, optionally substituted  $\text{C}_{1-4}$  alkyl, optionally substituted aryl, optionally substituted aryl  $\text{C}_{1-4}$ alkyl, optionally substituted heteroaryl, optionally substituted heteroaryl  $\text{C}_{1-4}$ alkyl, heterocyclic, heterocyclic $\text{C}_{1-4}$  alkyl, or  $\text{R}_4$  and  $\text{R}_5$  together with the nitrogen to which they are attached form a 5 to 7 member ring which may optionally comprise an additional heteroatom selected from O/N/S;



Y is independently selected from hydrogen; halogen; nitro; cyano; halosubstituted C<sub>1-10</sub> alkyl; C<sub>1-10</sub> alkyl; C<sub>2-10</sub> alkenyl; C<sub>1-10</sub> alkoxy; halosubstituted C<sub>1-10</sub> alkoxy; azide; S(O)<sub>t</sub>R<sub>4</sub>; hydroxy; hydroxy C<sub>1-4</sub>alkyl; aryl; aryl C<sub>1-4</sub> alkyl; aryloxy; aryl C<sub>1-4</sub> alkyloxy; heteroaryl; heteroarylalkyl; heteroarylC<sub>1-4</sub> alkyloxy; heterocyclic, heterocyclic C<sub>1-4</sub>alkyl; aryl C<sub>2-10</sub> alkenyl; heteroaryl C<sub>2-10</sub> alkenyl; heterocyclic C<sub>2-10</sub> alkenyl; NR<sub>4</sub>R<sub>5</sub>; C<sub>2-10</sub> alkenyl C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>10</sub>; S(O)<sub>3</sub>H; S(O)<sub>3</sub>R<sub>8</sub>; C<sub>1-10</sub> alkyl C(O)R<sub>11</sub>; C<sub>2-10</sub> alkenyl C(O)R<sub>11</sub>; C<sub>2-10</sub> alkenyl C(O)OR<sub>11</sub>; C(O)R<sub>11</sub>; C(O)OR<sub>12</sub>; OC(O)R<sub>11</sub>; NR<sub>4</sub>C(O)R<sub>11</sub>; or two Y moieties together may form O-(CH<sub>2</sub>)<sub>5</sub>O- or a 5 to 6 membered unsaturated ring;

n is an integer having a value of 1 to 3;

m is an integer having a value of 1 to 3;

R<sub>8</sub> is hydrogen or C<sub>1-4</sub> alkyl;

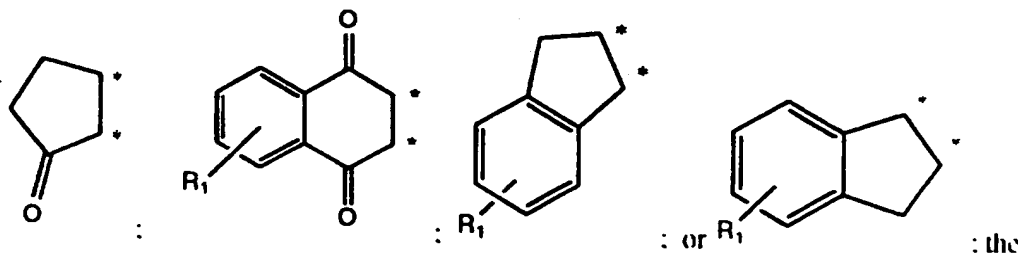
R<sub>10</sub> is C<sub>1-10</sub> alkyl C(O)<sub>2</sub>R<sub>8</sub>;

R<sub>11</sub> is hydrogen, C<sub>1-4</sub> alkyl, optionally substituted aryl, optionally substituted aryl C<sub>1-4</sub>alkyl,

optionally substituted heteroaryl, optionally substituted heteroarylC<sub>1-4</sub>alkyl, optionally substituted heterocyclic, or optionally substituted heterocyclicC<sub>1-4</sub>alkyl;

R<sub>12</sub> is hydrogen, C<sub>1-10</sub> alkyl, optionally substituted aryl or optionally substituted arylalkyl;

E is optionally selected from



asterix \* denoting point of attachment of the ring, with at least one E being present; or a pharmaceutically acceptably salt thereof.

Suitably, the variables for Formula (II), such as X, R, R<sub>1</sub>, R<sub>4</sub>, R<sub>5</sub>, R<sub>6</sub>, R<sub>7</sub>, R<sub>8</sub>, R<sub>9</sub>, Y, R<sub>a</sub>, R<sub>b</sub>, R<sub>c</sub>, n, m, and s terms, etc. are as defined in Formula (I) above. The E ring denoted by its point of attachment through the asterix (\*) may optionally be present. If it is not present the ring is a phenyl moiety which is substituted by the R and R<sub>1</sub> terms as shown. At least one E ring is necessary. The E ring may be substituted by the R<sub>1</sub> moiety in any ring, saturated or unsaturated, and is shown for purposes herein substituted only in the unsaturated ring(s).

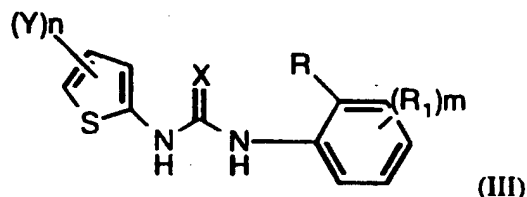
Exemplified compounds of Formula (III) are

N-[2-hydroxy-5-indanone]-N'-[2-bromophenyl] urea;

N-[1-hydroxyfluorene]-N'-[2-bromophenyl] urea;

N-[3-hydroxy-9,10-anthraquinon-2-yl]-N'-[2-bromophenyl] urea

Another aspect of the present invention are the novel compounds of Formula (III), or a pharmaceutically acceptable salt thereof, as described below, which are also useful in inhibiting the binding of IL-8 to its receptors in a mammal in need thereof. This invention also relates to the pharmaceutical compositions comprising a compound of Formula (III) and a pharmaceutically acceptable diluent or carrier. Compounds of Formula (III) are also useful for treating a chemokine mediated disease, wherein the chemokine is one which binds to an IL-8  $\alpha$  or  $\beta$  receptor and which method comprises administering an effective amount of a compound of Formula (III) or a pharmaceutically acceptable salt thereof. Compounds of Formula (III) are represented by the formula:



wherein

15 X is oxygen or sulfur;

R is any functional moiety having an ionizable hydrogen and a pKa of 10 or less;

R<sub>1</sub> is independently selected from hydrogen; halogen; nitro; cyano; halosubstituted C<sub>1-10</sub>

alkyl; C<sub>1-10</sub> alkyl; C<sub>2-10</sub> alkenyl; C<sub>1-10</sub> alkoxy; halosubstituted C<sub>1-10</sub> alkoxy; azide;

S(O)<sub>t</sub>R<sub>4</sub>; hydroxy; hydroxyC<sub>1-4</sub>alkyl; aryl; aryl C<sub>1-4</sub> alkyl; aryloxy; arylC<sub>1-4</sub> alkyloxy;

20 heteroaryl; heteroarylalkyl; heterocyclic, heterocyclicC<sub>1-4</sub>alkyl; heteroarylC<sub>1-4</sub> alkyloxy;

aryl C<sub>2-10</sub> alkenyl; heteroaryl C<sub>2-10</sub> alkenyl; heterocyclicC<sub>2-10</sub> alkenyl; NR<sub>4</sub>R<sub>5</sub>; C<sub>2-10</sub>

alkenyl C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>1(t)</sub>; S(O)<sub>3</sub>H; S(O)<sub>3</sub>R<sub>8</sub>; C<sub>1-10</sub> alkyl

C(O)R<sub>11</sub>; C<sub>2-10</sub> alkenyl C(O)R<sub>11</sub>; C<sub>2-10</sub> alkenyl C(O)OR<sub>11</sub>; C(O)R<sub>11</sub>; C(O)OR<sub>12</sub>;

OC(O)R<sub>11</sub>; NR<sub>4</sub>C(O)R<sub>11</sub>; or two R<sub>1</sub> moieties together may form O-(CH<sub>2</sub>)<sub>s</sub>O- or a 5 to 6

25 membered unsaturated ring;

t is 0, or an integer having a value of 1 or 2;

s is an integer having a value of 1 to 3;

R<sub>4</sub> and R<sub>5</sub> are independently hydrogen, optionally substituted C<sub>1-4</sub> alkyl, optionally

substituted aryl, optionally substituted aryl C<sub>1-4</sub>alkyl, optionally substituted heteroaryl,

30 optionally substituted heteroaryl C<sub>1-4</sub>alkyl, heterocyclic, heterocyclicC<sub>1-4</sub> alkyl, or R<sub>4</sub> and

R<sub>5</sub> together with the nitrogen to which they are attached form a 5 to 7 member ring which

may optionally comprise an additional heteroatom selected from O/N/S;

Y is independently selected from hydrogen; halogen; nitro; cyano; halosubstituted C<sub>1-10</sub> alkyl;

C<sub>1-10</sub> alkyl; C<sub>2-10</sub> alkenyl; C<sub>1-10</sub> alkoxy; halosubstituted C<sub>1-10</sub> alkoxy; azide; S(O)<sub>t</sub>R<sub>4</sub>;

hydroxy; hydroxyC<sub>1-4</sub>alkyl; aryl; aryl C<sub>1-4</sub> alkyl; aryloxy; arylC<sub>1-4</sub> alkyloxy; heteroaryl; heteroarylalkyl; heteroarylC<sub>1-4</sub> alkyloxy; heterocyclic, heterocyclicC<sub>1-4</sub>alkyl; aryl C<sub>2-10</sub> alkenyl; heteroaryl C<sub>2-10</sub> alkenyl; heterocyclicC<sub>2-10</sub> alkenyl; NR<sub>4</sub>R<sub>5</sub>; C<sub>2-10</sub> alkenyl C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>10</sub>; S(O)<sub>3</sub>H; S(O)<sub>3</sub>R<sub>8</sub>; C<sub>1-10</sub> alkyl C(O)R<sub>11</sub>; C<sub>2-10</sub> alkenyl C(O)R<sub>11</sub>; C<sub>2-10</sub> alkenyl C(O)OR<sub>11</sub>; C(O)R<sub>11</sub>; C(O)OR<sub>12</sub>; OC(O)R<sub>11</sub>; NR<sub>4</sub>C(O)R<sub>11</sub>; or two Y moieties together may form O-(CH<sub>2</sub>)<sub>5</sub>O- or a 5 to 6 membered unsaturated ring;

n is an integer having a value of 1 to 3;

m is an integer having a value of 1 to 3;

10 R<sub>8</sub> is hydrogen or C<sub>1-4</sub> alkyl;

R<sub>10</sub> is C<sub>1-10</sub> alkyl C(O)<sub>2</sub>R<sub>8</sub>;

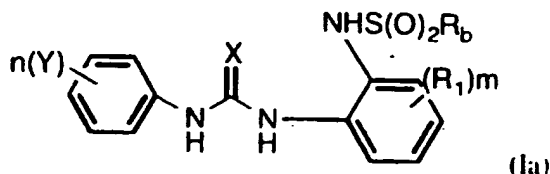
R<sub>11</sub> is hydrogen, C<sub>1-4</sub> alkyl, optionally substituted aryl, optionally substituted aryl C<sub>1-4</sub>alkyl, optionally substituted heteroaryl, optionally substituted heteroarylC<sub>1-4</sub>alkyl, optionally substituted heterocyclic, or optionally substituted heterocyclicC<sub>1-4</sub>alkyl;

15 R<sub>12</sub> is hydrogen, C<sub>1-10</sub> alkyl, optionally substituted aryl or optionally substituted arylalkyl; or a pharmaceutically acceptable salt thereof.

Suitably, the variables, etc. for Formula (II) are the same as those defined for Formula (I) above, such as for example the R variable.

Exemplified compounds of Formula (III) are N-(2-Hydroxy-4-nitrophenyl)-N'-(3-methoxy-2-thienyl)urea; and N-(2-hydroxy-5-nitrophenyl)-N'-(3-methoxy-2-thienyl)urea.

Another aspect of the present invention is the novel compounds of Formula (Ia), a subset of compounds of Formula (I) useful for treating a chemokine mediated disease as defined herein. This invention also relates to the pharmaceutical compositions comprising a compound of Formula (Ia) and a pharmaceutically acceptable diluent or carrier. The compounds of Formula (Ia) are represented by the structure:



wherein

X is oxygen or sulfur;

R<sub>a</sub> is an alkyl, aryl, arylC<sub>1-4</sub>alkyl, heteroaryl, heteroaryl C<sub>1-4</sub>alkyl, heterocyclic, or a heterocyclic C<sub>1-4</sub>alkyl moiety, all of which may be optionally substituted;

- R<sub>b</sub> is a NR<sub>6</sub>R<sub>7</sub>, alkyl, aryl, arylC<sub>1-4</sub>alkyl, aryl C<sub>2-4</sub>alkenyl, heteroaryl, heteroarylC<sub>1-4</sub>alkyl, heteroarylC<sub>2-4</sub> alkenyl, heterocyclic, or heterocyclic C<sub>1-4</sub>alkyl, or a heterocyclic C<sub>2-4</sub>alkenyl moiety, camphor, all of which may be optionally substituted one to three times independently by halogen; nitro; halosubstituted C<sub>1-4</sub> alkyl; C<sub>1-4</sub> alkyl; C<sub>1-4</sub> alkoxy;
- 5 NR<sub>9</sub>C(O)R<sub>a</sub>; C(O)NR<sub>6</sub>R<sub>7</sub>, S(O)<sub>3</sub>H, or C(O)OC<sub>1-4</sub> alkyl;
- R<sub>6</sub> and R<sub>7</sub> are independently hydrogen or a C<sub>1-4</sub>alkyl group, or R<sub>6</sub> and R<sub>7</sub> together with the nitrogen to which they are attached form a 5 to 7 member ring which ring may optionally contain an additional heteroatom which heteroatom is selected from oxygen, nitrogen or sulfur, which ring may be optionally substituted;
- 10 R<sub>9</sub> is hydrogen or a C<sub>1-4</sub> alkyl, preferably hydrogen;
- R<sub>1</sub> is independently selected from hydrogen; halogen; nitro; cyano; halosubstituted C<sub>1-10</sub> alkyl; C<sub>1-10</sub> alkyl; C<sub>2-10</sub> alkenyl; C<sub>1-10</sub> alkoxy; halosubstituted C<sub>1-10</sub> alkoxy; azide; S(O)<sub>1</sub>R<sub>4</sub>; hydroxy; hydroxy C<sub>1-4</sub>alkyl; aryl; aryl C<sub>1-4</sub> alkyl; aryloxy; aryl C<sub>1-4</sub> alkyloxy; heteroaryl; heteroarylalkyl; heterocyclic, heterocyclic C<sub>1-4</sub>alkyl; heteroaryl C<sub>1-4</sub> alkyloxy;
- 15 aryl C<sub>2-10</sub> alkenyl; heteroaryl C<sub>2-10</sub> alkenyl; heterocyclicC<sub>2-10</sub> alkenyl; NR<sub>4</sub>R<sub>5</sub>; C<sub>2-10</sub> alkenyl C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>10</sub>; S(O)<sub>3</sub>H; S(O)<sub>3</sub>R<sub>8</sub>; C<sub>1-10</sub> alkyl C(O)R<sub>11</sub>; C<sub>2-10</sub> alkenyl C(O)R<sub>11</sub>; C<sub>2-10</sub> alkenyl C(O)OR<sub>11</sub>; C(O)R<sub>11</sub>; C(O)OR<sub>12</sub>; OC(O) R<sub>11</sub>; NR<sub>4</sub>C(O)R<sub>11</sub>; or two R<sub>1</sub> moieties together may form O-(CH<sub>2</sub>)<sub>5</sub>O- or a 5 to 6 membered unsaturated ring;
- 20 t is 0, or an integer having a value of 1 or 2;
- s is an integer having a value of 1 to 3;
- R<sub>4</sub> and R<sub>5</sub> are independently hydrogen, optionally substituted C<sub>1-4</sub> alkyl, optionally substituted aryl, optionally substituted aryl C<sub>1-4</sub>alkyl, optionally substituted heteroaryl, optionally substituted heteroaryl C<sub>1-4</sub>alkyl, heterocyclic, heterocyclicC<sub>1-4</sub> alkyl, or R<sub>4</sub> and
- 25 R<sub>5</sub> together with the nitrogen to which they are attached form a 5 to 7 member ring which may optionally comprise an additional heteroatom selected from O/N/S;
- Y is independently selected from hydrogen; halogen; nitro; cyano; halosubstituted C<sub>1-10</sub> alkyl; C<sub>1-10</sub> alkyl; C<sub>2-10</sub> alkenyl; C<sub>1-10</sub> alkoxy; halosubstituted C<sub>1-10</sub> alkoxy; azide; S(O)<sub>1</sub>R<sub>4</sub>; hydroxy; hydroxyC<sub>1-4</sub>alkyl; aryl; aryl C<sub>1-4</sub> alkyl; aryloxy; arylC<sub>1-4</sub> alkyloxy; heteroaryl; heteroarylalkyl; heteroarylC<sub>1-4</sub> alkyloxy; heterocyclic, heterocyclicC<sub>1-4</sub>alkyl; aryl C<sub>2-10</sub> alkenyl; heteroaryl C<sub>2-10</sub> alkenyl; heterocyclicC<sub>2-10</sub> alkenyl; NR<sub>4</sub>R<sub>5</sub>; C<sub>2-10</sub> alkenyl C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>10</sub>; S(O)<sub>3</sub>H; S(O)<sub>3</sub>R<sub>8</sub>; C<sub>1-10</sub> alkyl C(O)R<sub>11</sub>; C<sub>2-10</sub> alkenyl C(O)R<sub>11</sub>; C<sub>2-10</sub> alkenyl C(O)OR<sub>11</sub>; C(O)R<sub>11</sub>; C(O)OR<sub>12</sub>; OC(O) R<sub>11</sub>; NR<sub>4</sub>C(O)R<sub>11</sub>; or two Y moieties together may form O-(CH<sub>2</sub>)<sub>5</sub>O- or a 5 to 6 membered
- 30 unsaturated ring;
- 35 n is an integer having a value of 1 to 3;
- m is an integer having a value of 1 to 3;
- R<sub>8</sub> is hydrogen or C<sub>1-4</sub> alkyl;

R<sub>10</sub> is C<sub>1-10</sub> alkyl C(O)<sub>2</sub>R<sub>8</sub>;

R<sub>11</sub> is hydrogen, C<sub>1-4</sub> alkyl, optionally substituted aryl, optionally substituted aryl C<sub>1-4</sub>alkyl, optionally substituted heteroaryl, optionally substituted heteroarylC<sub>1-4</sub>alkyl, optionally substituted heterocyclic, or optionally substituted heterocyclicC<sub>1-4</sub>alkyl;

5 R<sub>12</sub> is hydrogen, C<sub>1-10</sub> alkyl, optionally substituted aryl or optionally substituted arylalkyl; or a pharmaceutically acceptable salt thereof.

10 A preferred ring substitution for R<sub>1</sub> variable is monosubstituted in the 3-position, or the 4- position, or di-substituted in the 3,4- position. The substituent group is suitably an electron withdrawing moiety. Preferably R<sub>1</sub> is nitro, halogen, cyano, trifluoromethyl group, or C(O)NR<sub>4</sub>R<sub>5</sub>.

15 While Y may be substituted in any of the 5 ring positions, preferably the ring with the Y moiety is mono-substituted in the 2-position or 3- position, with the 4- preferably being unsubstituted. If the ring is di-substituted, substituents are preferably in the 2', 3'- positions of a monocyclic ring. While both R<sub>1</sub> and Y can both be hydrogen, it is preferred that at least one of the rings be substituted, preferably both rings are at least mono-substituted, i.e. n and m are each equal to 1 or more.

20 Y is more preferably a mono-substituted halogen, disubstituted halogen, mono-substituted alkoxy, disubstituted alkoxy, methylenedioxy, aryl, or alkyl, preferably these groups are substituted in the 2'- position or 2',3'-position.

Exemplified compounds of Formula (Ia) are

N-(4-Nitro 2-(phenylsulfonylamino)phenyl)-N'-phenyl urea  
 N-[(2-Phenylsulfamido) 4-cyanophenyl]- N'-(2-bromo phenyl) urea  
 25 N-(2-(Amino sulfonylamino phenyl) phenyl) N'-(2-bromo phenyl) urea  
 N-(2-(Amino sulfonyl styryl) phenyl) N'-(2-bromo phenyl) urea  
 2-[(3,4 Di-methoxyphenylsulfonyl)amino] phenyl) N'-(2-bromo phenyl) urea  
 N-(2-[(4-Acetamidophenylsulfonyl)amino] phenyl) N'-(2-bromo phenyl) urea  
 N-(2-(Amino sulfonyl (2-thiophene) phenyl) N'-(2-bromo phenyl) urea  
 30 N-(2-(Amino sulfonyl (3-tolyl) phenyl) N'-(2-bromo phenyl) urea  
 N-(2-(Amino sulfonyl (8-quinoliny)) phenyl) N'-(2-bromo phenyl) urea  
 N-(2-(Amino sulfonyl benzyl) phenyl) N'-(2-bromo phenyl) urea  
 N-[2-[[2-(Trifluoromethyl)phenyl]sulfonyl]amino]phenyl]-N'-(2-bromophenyl)urea  
 N-(2-Bromophenyl)-N'-[2-dimethylaminosulfonylamino]phenyl]urea  
 35 N-[2-(Phenethylsulfonylamino)phenyl]-N'-(2-bromophenyl)urea  
 N-[2-[(2-Acetamido-4-methylthiazol-5-yl)sulfonylamino]phenyl]-N'-(2-bromophenyl)urea  
 N-[2-[(2,3-Dichlorothien-5-yl)]sulfonylamino]phenyl]-N'-(2-bromophenyl)urea  
 N-[2-[(3,5-Bis(trifluoromethyl)phenyl)sulfonylamino]phenyl]-N'-(2-bromophenyl)urea

- 20 -

N-[2-[(2-Benzyl)sulfonylamino]-(5-trifluoromethyl)phenyl]-N'-(2-bromophenyl)urea

N-[2-[2-(3-Nitrophenyl)sulfonylamino]phenyl]-N'-(2-bromophenyl)urea

N-[2-[2-(4-Phenoxyphenyl)sulfonylamino]phenyl]-N'-(2-bromophenyl) urea

5 N-[2-[(1S)-10-Camphorsulfonylamino]phenyl]-N'-(2-bromophenyl)urea

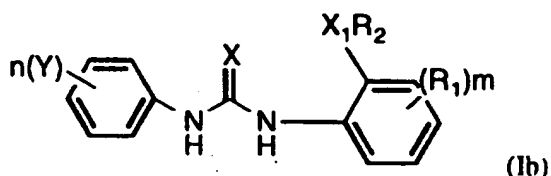
N-[2-[(1R)-10-Camphorsulfonylamino]phenyl]-N'-(2-bromophenyl)urea

N-[2-[2-(2-Nitro-(4-trifluoromethyl)phenyl)sulfonylamino]phenyl]-N'-(2-bromophenyl)urea

N-[2-(2-Amino-(4-trifluoromethyl) phenyl) sulfonylamino] phenyl]- N'-(2-bromophenyl)urea

10 N-[2-(aminosulfonyl phenyl) 3-amino phenyl] N'-(2-bromo phenyl) urea

Another aspect of the present invention is the novel compounds of Formula (Ib), a subset of compounds of Formula (I) useful for treating a chemokine mediated disease. This invention also relates to the pharmaceutical compositions comprising a compound of Formula (Ib) and a pharmaceutically acceptable diluent or carrier. The compounds of Formula (Ib) are represented by the structure:



wherein

20 X is oxygen or sulfur;

X<sub>1</sub> is oxygen or sulfur;R<sub>1</sub> is independently selected from hydrogen; halogen; nitro; cyano; halosubstituted C<sub>1-10</sub>alkyl; C<sub>1-10</sub> alkyl; C<sub>2-10</sub> alkenyl; C<sub>1-10</sub> alkoxy; halosubstituted C<sub>1-10</sub> alkoxy; azide;S(O)<sub>t</sub>R<sub>4</sub>; hydroxy; hydroxyC<sub>1-4</sub>alkyl; aryl; aryl C<sub>1-4</sub> alkyl; aryloxy; arylC<sub>1-4</sub> alkyloxy;25 heteroaryl; heteroarylalkyl; heterocyclic, heterocyclic C<sub>1-4</sub>alkyl; heteroaryl C<sub>1-4</sub> alkyloxy;aryl C<sub>2-10</sub> alkenyl; heteroaryl C<sub>2-10</sub> alkenyl; heterocyclicC<sub>2-10</sub> alkenyl; NR<sub>4</sub>R<sub>5</sub>; C<sub>2-10</sub>alkenyl C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>10</sub>; S(O)<sub>3</sub>H; S(O)<sub>3</sub>R<sub>8</sub>; C<sub>1-10</sub> alkylC(O)R<sub>11</sub>; C<sub>2-10</sub> alkenyl C(O)R<sub>11</sub>; C<sub>2-10</sub> alkenyl C(O)OR<sub>11</sub>; C(O)R<sub>11</sub>; C(O)OR<sub>12</sub>;OC(O)R<sub>11</sub>; NR<sub>4</sub>C(O)R<sub>11</sub>; or two R<sub>1</sub> moieties together may form O-(CH<sub>2</sub>)<sub>5</sub>O- or a 5 to 6

30 membered unsaturated ring;

t is 0, or an integer having a value of 1 or 2;

s is an integer having a value of 1 to 3;

R<sub>2</sub> is a substituted aryl, heteroaryl, or heterocyclic ring which ring has a functional moiety providing the ionizable hydrogen having a pK<sub>a</sub> of 10 or less;

R<sub>4</sub> and R<sub>5</sub> are independently hydrogen, optionally substituted C<sub>1-4</sub> alkyl, optionally substituted aryl, optionally substituted aryl C<sub>1-4</sub>alkyl, optionally substituted heteroaryl, optionally substituted heteroaryl C<sub>1-4</sub>alkyl, heterocyclic, heterocyclicC<sub>1-4</sub> alkyl, or R<sub>4</sub> and R<sub>5</sub> together with the nitrogen to which they are attached form a 5 to 7 member ring which may optionally comprise an additional heteroatom selected from O/N/S;

Y is independently selected from hydrogen; halogen; nitro; cyano; halosubstituted C<sub>1-10</sub> alkyl; C<sub>1-10</sub> alkyl; C<sub>2-10</sub> alkenyl; C<sub>1-10</sub> alkoxy; halosubstituted C<sub>1-10</sub> alkoxy; azide; S(O)<sub>1</sub>R<sub>4</sub>; hydroxy; hydroxyC<sub>1-4</sub>alkyl; aryl; aryl C<sub>1-4</sub> alkyl; aryloxy; arylC<sub>1-4</sub> alkyloxy; heteroaryl; heteroarylalkyl; heteroarylC<sub>1-4</sub> alkyloxy; heterocyclic, heterocyclicC<sub>1-4</sub>alkyl; aryl C<sub>2-10</sub> alkenyl; heteroaryl C<sub>2-10</sub> alkenyl; heterocyclicC<sub>2-10</sub> alkenyl; NR<sub>4</sub>R<sub>5</sub>; C<sub>2-10</sub> alkenyl C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>10</sub>; S(O)<sub>3</sub>H; S(O)<sub>3</sub>R<sub>8</sub>; C<sub>1-10</sub> alkyl C(O)R<sub>11</sub>; C<sub>2-10</sub> alkenyl C(O)R<sub>11</sub>; C<sub>2-10</sub> alkenyl C(O)OR<sub>11</sub>; C(O)R<sub>11</sub>; C(O)OR<sub>12</sub>; OC(O)R<sub>11</sub>; NR<sub>4</sub>C(O)R<sub>11</sub>; or two Y moieties together may form O-(CH<sub>2</sub>)<sub>5</sub>O- or a 5 to 6 membered unsaturated ring;

n is an integer having a value of 1 to 3;

m is an integer having a value of 1 to 3;

R<sub>8</sub> is hydrogen or C<sub>1-4</sub> alkyl;

R<sub>10</sub> is C<sub>1-10</sub> alkyl C(O)<sub>2</sub>R<sub>8</sub>;

R<sub>11</sub> is hydrogen, C<sub>1-4</sub> alkyl, optionally substituted aryl, optionally substituted aryl C<sub>1-4</sub>alkyl, optionally substituted heteroaryl, optionally substituted heteroarylC<sub>1-4</sub>alkyl, optionally substituted heterocyclic, or optionally substituted heterocyclicC<sub>1-4</sub>alkyl;

R<sub>12</sub> is hydrogen, C<sub>1-10</sub> alkyl, optionally substituted aryl or optionally substituted arylalkyl; or a pharmaceutically acceptable salt thereof.

Suitably, the variable, etc. for Formula (Ib) are the same as those defined for Formula (I) above, such as for example the functional moieties on the R<sub>2</sub> group having an ionizable hydrogen with a pK<sub>a</sub> of 10 or less. Suitably such functional groups include, but are not limited to, hydroxy, carboxylic acid, thiol, -NH-C(O)R<sub>a</sub>, -C(O)NR<sub>6</sub>R<sub>7</sub>, substituted sulfonamides of the formula -NHS(O)<sub>2</sub>R<sub>b</sub>, -S(O)<sub>2</sub>NHR<sub>c</sub>, NHC(X<sub>2</sub>)NHR<sub>b</sub>, or tetrazoyl (as defined for Formula (I).

Suitably for compounds of Formula (Ib), a preferred ring substitution for R<sub>1</sub> is in the 3-position, the 4- position or is preferably di substituted in the 3,4- position. The substituent group is suitably an electron withdrawing moiety. Preferably R<sub>1</sub> is nitro, halogen, cyano, trifluoromethyl group, or C(O)NR<sub>4</sub>R<sub>5</sub>.

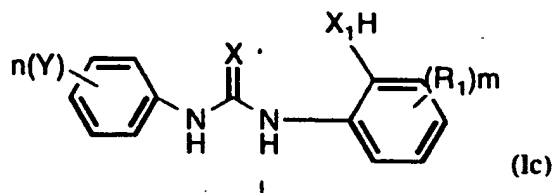
While Y may be substituted in any of the 5 ring positions, preferably the ring with the Y moiety is mono-substituted in the 2-position or 3- position, with the 4- preferably being unsubstituted. If the ring is disubstituted, substituents are preferably in the 2' or 3' position of

- 22 -

a monocyclic ring. While both  $R_1$  and  $Y$  can both be hydrogen, it is preferred that at least one of the rings be substituted, preferably both rings are at least mono-substituted, i.e.  $n$  and  $m$  are each equal to 1 or more.

- Suitably for compounds of Formula (Ib),  $Y$  is more preferably disubstituted halogen, mono-substituted halogen, disubstituted alkoxy, mono-substituted alkoxy, methylenedioxy, aryl, or alkyl, preferably in the 2' position or 2',3'-position.

- Another aspect of the present invention is the novel compounds of Formula (Ic), a subset of compounds of Formula (I) useful for treating a chemokine mediated disease. This invention also relates to the pharmaceutical compositions comprising a compound of Formula (Ic) and a pharmaceutically acceptable diluent or carrier. The compounds of Formula (Ic) are represented by the structure:



wherein

- 15 X is oxygen or sulfur;  
 $X_1$  is oxygen or sulfur;  
 $R_1$  is independently selected from hydrogen; halogen; nitro; cyano; halosubstituted  $C_{1-10}$  alkyl;  $C_{1-10}$  alkyl;  $C_{2-10}$  alkenyl;  $C_{1-10}$  alkoxy; halosubstituted  $C_{1-10}$  alkoxy; azide;  $S(O)_t R_4$ ; hydroxy; hydroxy  $C_{1-4}$  alkyl; aryl; aryl  $C_{1-4}$  alkyl; aryloxy; aryl  $C_{1-4}$  alkyloxy;  
 20 heteroaryl; heteroarylalkyl; heterocyclic; heterocyclic  $C_{1-4}$  alkyl; heteroaryl  $C_{1-4}$  alkyloxy; aryl  $C_{2-10}$  alkenyl; heteroaryl  $C_{2-10}$  alkenyl; heterocyclic  $C_{2-10}$  alkenyl;  $NR_4 R_5$ ;  $C_{2-10}$  alkenyl  $C(O)NR_4 R_5$ ;  $C(O)NR_4 R_5$ ;  $C(O)NR_4 R_{10}$ ;  $S(O)_3 H$ ;  $S(O)_3 R_8$ ;  $C_{1-10}$  alkyl  $C(O)R_{11}$ ;  $C_{2-10}$  alkenyl  $C(O)R_{11}$ ;  $C_{2-10}$  alkenyl  $C(O)OR_{11}$ ;  $C(O)R_{11}$ ;  $C(O)OR_{12}$ ;  $OC(O)R_{11}$ ;  $NR_4 C(O)R_{11}$ ; or two  $R_1$  moieties together may form  $O-(CH_2)_5 O-$  or a 5 to 6  
 25 membered unsaturated ring;  
 $t$  is 0, or an integer having a value of 1 or 2;  
 $s$  is an integer having a value of 1 to 3;  
 $R_4$  and  $R_5$  are independently hydrogen, optionally substituted  $C_{1-4}$  alkyl, optionally substituted aryl, optionally substituted aryl  $C_{1-4}$  alkyl, optionally substituted heteroaryl,  
 30 optionally substituted heteroaryl  $C_{1-4}$  alkyl, heterocyclic, heterocyclic  $C_{1-4}$  alkyl, or  $R_4$  and  $R_5$  together with the nitrogen to which they are attached form a 5 to 7 member ring which may optionally comprise an additional heteroatom selected from O/N/S;  
 $Y$  is independently selected from halogen; nitro; cyano; halosubstituted  $C_{1-10}$  alkyl;  $C_{1-10}$  alkyl;  $C_{2-10}$  alkenyl;  $C_{1-10}$  alkoxy; halosubstituted  $C_{1-10}$  alkoxy; azide;  $S(O)_t R_4$ ;  
 35 hydroxy; hydroxy  $C_{1-4}$  alkyl; aryl; aryl  $C_{1-4}$  alkyl; aryloxy; aryl  $C_{1-4}$  alkyloxy; heteroaryl;



heteroarylalkyl; heteroarylC<sub>1-4</sub> alkyloxy; heterocyclic, heterocyclic C<sub>1-4</sub>alkyl; aryl C<sub>2-10</sub> alkenyl; heteroaryl C<sub>2-10</sub> alkenyl; heterocyclic C<sub>2-10</sub> alkenyl; NR<sub>4</sub>R<sub>5</sub>; C<sub>2-10</sub> alkenyl C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>10</sub>; S(O)<sub>3</sub>H; S(O)<sub>3</sub>R<sub>8</sub>; C<sub>1-10</sub> alkyl C(O)R<sub>11</sub>; C<sub>2-10</sub> alkenyl C(O)R<sub>11</sub>; C<sub>2-10</sub> alkenyl C(O)OR<sub>11</sub>; C(O)R<sub>11</sub>; C(O)OR<sub>12</sub>; OC(O) R<sub>11</sub>; NR<sub>4</sub>C(O)R<sub>11</sub>; or two Y moieties together may form O-(CH<sub>2</sub>)<sub>5</sub>O- or a 5 to 6 membered unsaturated ring:

n is an integer having a value of 1 to 3;

m is an integer having a value of 1 to 3;

R<sub>8</sub> is hydrogen or C<sub>1-4</sub> alkyl;

10 R<sub>10</sub> is C<sub>1-10</sub> alkyl C(O)<sub>2</sub>R<sub>8</sub>;

R<sub>11</sub> is hydrogen, C<sub>1-4</sub> alkyl, optionally substituted aryl, optionally substituted aryl C<sub>1-4</sub>alkyl, optionally substituted heteroaryl, optionally substituted heteroarylC<sub>1-4</sub>alkyl, optionally substituted heterocyclic, or optionally substituted heterocyclicC<sub>1-4</sub>alkyl;

R<sub>12</sub> is hydrogen, C<sub>1-10</sub> alkyl, optionally substituted aryl or optionally substituted arylalkyl;

15 provided that

when n = 1 than Y is substituted in the 2- or 3- position;

when n = 2 than Y is di-substituted in the 2'- 3'- position, the 2'-5'- position, the 2'-6' position, the 3'-5' or the 3'-6' position;

when h = 3 than Y is trisubstituted in the 2'-3'-5' or the 2'-3'-6'- positions;

20 further provided that

when X<sub>1</sub> is O, m=2, R<sub>1</sub> is 2-t-butyl, 4-methyl, and n=3 than Y is not 2'-OH, 3'-t-butyl, 5'-methyl;

when X<sub>1</sub> is O, m=1, R<sub>1</sub> is 4-methyl, and n=2 than Y is not 2'-OH, 5'-methyl;

when X<sub>1</sub> is O, m=1, R<sub>1</sub> is hydrogen, and n=2 than Y is not 2'-6'-diethyl;

25 when X<sub>1</sub> is O, m=1, R<sub>1</sub> is 6-OH, and n=2 than Y is not 2'-5'-methyl;

when X<sub>1</sub> is S, m=1, R<sub>1</sub> is 4-ethyl, and n=1 than Y is not 2-methoxy;

or a pharmaceutically acceptably salt thereof.

30 Suitably, the variables, etc. for Formula (Ic) are the same as those defined for Formula (I) above unless indicated.

Suitably for compounds of Formula (Ic), a preferred ring substitution for R<sub>1</sub> is in the 3-position, the 4- position or di substituted in the 3,4- position. Preferably R<sub>1</sub> is other than hydrogen. The substituent group is suitably an electron withdrawing moiety. Preferably R<sub>1</sub> is  
35 nitro, halogen, cyano, trifluoromethyl group, or C(O)NR<sub>4</sub>R<sub>5</sub>.

While Y may be substituted in any of the 5 ring positions, preferably the ring with the Y moiety is mono-substituted in the 2-position or 3- position, with the 4- preferably being

unsubstituted. If the ring is disubstituted, substituents are preferably in the 2' or 3' position of a monocyclic ring. While both R<sub>1</sub> and Y can both be hydrogen, it is preferred that at least one of the rings be substituted, preferably both rings are at least mono-substituted, i.e. n and m are each equal to 1 or more.

- 5 Suitably for compounds of Formula (Ic), Y is more preferably a mono-substituted halogen, disubstituted halogen, mono-substituted alkoxy, disubstituted alkoxy, methylenedioxy, aryl, or alkyl, preferably with these groups in the 2' position or 2,3-position.

Exemplified compounds of Formula (Ic) are:

- N-[2-Hydroxy-4-(methoxycarbonyl)phenyl]-N'-phenylurea;  
 10 N-[2-Hydroxy-5-nitro-phenyl]-N'-phenyl urea  
 N-(2-Hydroxy-4-fluorophenyl)-N'-phenyl urea  
 N-[2-Hydroxy-4-(trifluoromethyl)phenyl]-N'-phenyl urea  
 N-(2-Hydroxy-4-nitrophenyl)-N'-(2-hydroxy-4-nitrophenyl) urea  
 N-(2-Hydroxy-4-nitrophenyl)-N'-phenyl-thiourea  
 15 N-(2-Hydroxy-5-nitrophenyl)-N'-(3-methoxy-2-thienyl)urea  
 N-(2-Hydroxy-4-nitrophenyl)-N'-(3-methoxy-2-thienyl)urea  
 N-(2-Hydroxy-4-nitrophenyl)-N'-(3-methoxyphenyl)urea  
 N-(2-Hydroxy-4-nitrophenyl)-N'-(2-methoxyphenyl)urea  
 N-(2-Hydroxy-4-nitrophenyl)-N'-(3-trifluoromethylphenyl)urea  
 20 N-(2-Hydroxy-4-nitrophenyl)-N'-(2-trifluoromethylphenyl)urea  
 N-(2-Hydroxy-4-nitrophenyl)-N'-(4-trifluoromethylphenyl)urea  
 N-(2-Hydroxy-4-nitrophenyl)-N'-(2-bromophenyl)urea  
 N-(2-Hydroxy-4-nitrophenyl)-N'-(3-bromophenyl)urea  
 N-(2-Hydroxy-4-nitrophenyl)-N'-(4-bromophenyl)urea  
 25 N-(2-Hydroxy-4-nitrophenyl)-N'-(2-phenylphenyl)urea  
 N-(2-Hydroxy-4-nitrophenyl)-N'-(2-nitrophenyl)urea  
 N-(2-Hydroxy-4-nitrophenyl)-N'-(2-fluorophenyl)urea  
 N-(2-Hydroxy-4-nitrophenyl)-N'-(2,6-difluorophenyl)urea  
 N-(2-Hydroxy-4-nitrophenyl)-N'-(2-ethoxyphenyl)urea  
 30 N-(2-Hydroxy-4-nitrophenyl)-N'-(2-ethylphenyl)urea  
 N-(2-Hydroxy-4-nitrophenyl)-N'-(2-trifluoromethoxyphenyl)urea  
 N-(2-Hydroxy-4-nitrophenyl)-N'-(2-methylthiophenyl)urea  
 N-(2-Hydroxy-4-nitro-phenyl)-N'-(2-chloro-6-methyl phenyl)urea  
 N-(2-Hydroxy-4-nitro-phenyl)-N'-(2-sulfoxymethyl phenyl)urea  
 35 N-(2-Hydroxy-4-trifluoromethyl phenyl)-N'-(2-bromo phenyl)urea  
 N-(2-Hydroxy-4-trifluoromethyl phenyl)-N'-(2-phenyl phenyl)urea  
 N-(2-Hydroxy-4-carbomethoxy phenyl)-N'-(2-phenyl phenyl)urea  
 N-(2-Hydroxy-4-nitrophenyl)-N'-(2,3-dichloro phenyl)urea

- N-(2-Hydroxy-4-nitrophenyl)-N'-(2,4-dichloro phenyl) urea  
N-(2-Hydroxy-4-nitrophenyl)-N'-(2-chloro phenyl) urea  
N-(2-Hydroxy-4-nitrophenyl)-N'-(2,4-dibromo phenyl) urea  
N-(2-Hydroxy-1-naphthyl)-N'-(2-bromo phenyl) urea
- 5 N-(2-Hydroxy-4-nitrophenyl)-N'-(2,3-methylenedioxyphenyl)urea  
N-(2-Hydroxy-4-nitrophenyl) N'-(3-chloro 2-methoxy phenyl) urea  
N-[2-Hydroxy-4-(Benzylamino)carbonyl phenyl]-N'-(2-bromophenyl)urea  
N-(2-Hydroxy-4-nitro phenyl)-N'-(2-phenoxy phenyl) urea  
N-(2-Hydroxy-4-fluoro phenyl)-N'-(2-bromo phenyl) urea
- 10 N-(2-Hydroxy-3,4-difluoro phenyl)-N'-(2-bromo phenyl) urea  
N-(2-Hydroxy 4-phenyl phenyl) N'-(2-bromo phenyl) urea  
N-(2-Hydroxy 4-methyl phenyl)-N'-(2-bromo phenyl) urea  
N-(2-Hydroxy-4-nitro phenyl)-N'-(2-phenylamino phenyl) urea  
N-(2-Hydroxy 3-carboxyphenyl)-N'-(2-bromo phenyl) urea
- 15 N-(2-Sulfhydryl-4-bromo phenyl)-N'-(2-bromo phenyl) urea  
N-(2-Hydroxy 4-nitro phenyl)-N'-(2-iodo phenyl) urea  
N-(2-Hydroxy 4-nitro phenyl)-N'-(2-bromo phenyl) thiourea  
N-(2-Hydroxy-4-azidophenyl)-N'-(2-methoxyphenyl)urea  
N-[2-Hydroxy-5-cyanophenyl]-N'-[2-bromophenyl] urea
- 20 N-[2-Hydroxy-3-fluorophenyl]-N'-[2-bromophenyl] urea  
N-[2-Hydroxy-3-fluoro-5-bromophenyl]-N'-[2-bromophenyl] urea  
N-[2-Hydroxy-3-chlorophenyl]-N'-[2-bromophenyl] urea  
N-[2-Hydroxy-3-trifluoromethylphenyl]-N'-[2-bromophenyl] urea  
N-[2-hydroxy-3,4-diphenyl phenyl]-N'-[2-bromophenyl] urea
- 25 N-[2-Hydroxy-3-glycine methylester carbonyl phenyl]-N'-[2-bromophenyl] urea  
N-[2-Hydroxy-3-glycine carbonyl phenyl]-N'-[2-bromophenyl] urea  
N-[2-Hydroxy-3,5-dichlorophenyl]-N'-[2-bromophenyl] urea  
N-[2-Hydroxy-3-nitrophenyl]-N'-[2-bromophenyl] urea  
N-[2-Hydroxy-3,4-dichlorophenyl]-N'-[2-bromophenyl] urea
- 30 N-[2-Hydroxy-3-cyanophenyl]-N'-[2-bromophenyl] urea  
N-[2-Hydroxy-4-cyanophenyl]-N'-[2-bromophenyl] urea  
N-[2-Hydroxy-4-cyanophenyl]-N'-[4-methoxyphenyl] urea  
N-[2-Hydroxy-4-cyanophenyl]-N'-[2-phenylphenyl] urea  
N-[2-Hydroxy-4-cyanophenyl]-N'-[2-methylphenyl] urea
- 35 N-[2-Hydroxy-4-cyanophenyl]-N'-[2-trifluoromethylphenyl] urea  
N-[2-Hydroxy-4-cyanophenyl]-N'-[3-trifluoromethylphenyl] urea  
N-[2-Hydroxy-4-cyanophenyl]-N'-[4-trifluoromethylphenyl] urea  
N-[2-Hydroxy-3-n-propylphenyl]-N'-[2-bromophenyl] urea

- N-[2-Hydroxy-4-ethylphenyl]-N'-[2-bromophenyl] urea  
N-[2-Hydroxy-3-phenylaminocarbonyl phenyl]-N'-[2-bromophenyl] urea  
N-[2-Hydroxy-3-cyano-4-methylphenyl]-N'-[2-bromophenyl] urea  
N-[2-Hydroxy-4-carbophenyl phenyl]-N'-[2-bromophenyl] urea  
5 N-[2-Hydroxy-3-carbophenyl phenyl]-N'-[2-bromophenyl] urea  
N-[2-Hydroxy-3-benzyloxy phenyl]-N'-[2-bromophenyl] urea  
(E)-N-[4-[2-(Methoxycarbonyl) ethenyl]-2-hydroxyphenyl]-N'-[2-bromophenyl] urea  
(E)-N-[3-[2-(Methoxycarbonyl)ethenyl]-2-hydroxyphenyl]-N'-[2-bromophenyl]urea-N'- [2-bromophenyl] urea  
10 (E)-N-[3-[2-(Aminocarbonyl)ethenyl]-2-hydroxyphenyl]-N'-[2-bromophenyl]urea-N'-[2-bromophenyl] urea  
(E)-N-[4-[2-(Aminocarbonyl)ethenyl]-2-hydroxyphenyl]-N'-[2-bromophenyl]urea-N'-[2-bromophenyl] urea  
N-[2-Hydroxy-4-benzamide phenyl]-N'-[2-bromophenyl] urea  
15 N-[2-Hydroxy-4-aminocarbonyl phenyl]-N'-[2-bromophenyl] urea  
N-(2-Hydroxy-3,5,6-trifluorophenyl)-N'-(2-bromophenyl)urea  
N-(2-Hydroxy-3-fluoro-4-trifluoromethylphenyl)-N'-(2-bromophenyl)urea  
N-(2-Hydroxy-3-iodophenyl)-N'-(2-bromophenyl)urea  
N-[2-Hydroxy-4-cyanophenyl]-N'-[4-phenylphenyl] urea  
20 N-[2-Hydroxy-4-cyanophenyl]-N'-[2,3-dichlorophenyl] urea  
N-[2-Hydroxy-4-cyanophenyl]-N'-[2-methoxyphenyl] urea  
N-[2-Hydroxy-4-cyanophenyl]-N'-[3-methoxyphenyl] urea  
N-[2-Hydroxy-5-fluorophenyl]-N'-[2-bromophenyl] urea  
N-[2-Hydroxy-5-trifluoromethylphenyl]-N'-[2-bromophenyl] urea  
25 N-[2-Hydroxyphenyl]-N'-[2-bromophenyl] urea  
N-[Trans-3-styrl-2-hydroxyphenyl]-N'-[2-bromophenyl] urea  
N-[2-Hydroxy-3,4-dichlorophenyl]-N'-[2-methoxyphenyl] urea  
N-[2-Hydroxy-3,4-dichlorophenyl]-N'-[4-methoxyphenyl] urea  
N-[2-Hydroxy-3,4-dichlorophenyl]-N'-[3-trifluoromethylphenyl] urea  
30 N-[2-Hydroxy-3,4-dichlorophenyl]-N'-[2-phenylphenyl] urea  
N-[2-Hydroxy-3,4-dichlorophenyl]-N'-[4-phenylphenyl] urea  
N-[2-Hydroxy-3,4-dichlorophenyl]-N'-[2,3-dichlorophenyl] urea  
N-[2-Hydroxy-4-isopropylphenyl]-N'-[3-trifluoromethylphenyl] urea  
N-[2-Hydroxy-3-naphthyl]-N'-[2,3-dichlorophenyl] urea  
35 N-(2-Hydroxy-4-azidophenyl)-N'-(2-iodophenyl)urea  
N-(2-Hydroxy-3-azidophenyl)-N'-(2-bromophenyl)urea  
N-[2-Hydroxy-3-cyanophenyl]-N'-[2-methoxyphenyl] urea  
N-[2-Hydroxy-3-cyanophenyl]-N'-[3-trifluoromethylphenyl] urea

- N-[2-Hydroxy-3-cyanophenyl]-N'-(2-phenylphenyl) urea  
 N-[2-Hydroxy-3-cyanophenyl]-N'-(2,3-dichlorophenyl) urea  
 N-[2-Hydroxy-4-isopropylphenyl]-N'-(2,3-dichlorophenyl) urea  
 N-[2-Hydroxy-4-isopropylphenyl]-N'-(2-chloro-5-trifluoromethylphenyl) urea  
 5 N-[2-Hydroxy-3-phenylphenyl]-N'-(2,3-dichlorophenyl) urea  
 N-[2-Hydroxy-5-nitrophenyl]-N'-(2-methoxyphenyl) urea  
 N-[2-Hydroxy-5-nitrophenyl]-N'-(3-trifluoromethylphenyl) urea  
 N-[2-Hydroxy-5-nitrophenyl]-N'-(2-phenylphenyl) urea  
 N-[2-Hydroxy-5-nitrophenyl]-N'-(2,3-dichlorophenyl) urea  
 10 N-[2-Hydroxy-5-ethylsulfonylphenyl]-N'-(2,3-dichlorophenyl) urea  
 N-[2-Hydroxy-3,4-dichlorophenyl]-N'-(2,4 dimethoxyphenyl) urea  
 N-[2-Hydroxy-3,4-dichlorophenyl]-N'-(2-chloro-5-trifluoromethylphenyl) urea  
 N-[2-Hydroxy-3,4-dichlorophenyl]-N'-(benzyl) urea  
 N-[2-Hydroxy-4-isopropylphenyl]-N'-(3-trifluoromethylphenyl) urea  
 15 N-[2-Hydroxy-3-naphthyl]-N'-(3-trifluoromethylphenyl) urea  
 N-[2-Hydroxy-3-naphthyl]-N'-(2,3-dichlorophenyl) urea  
 N-[2-Hydroxy-3-naphthyl]-N'-(benzyl) urea  
 N-[2-hydroxy-3-(phenylaminocarbonyl) phenyl]-N'-(benzoyl) urea  
 N-[2-Hydroxy-3-trifluoromethylphenyl]-N'-(benzoyl) urea  
 20 N-[2-Hydroxy-4-cyanophenyl]-N'-(benzoyl) urea  
 N-[2-Hydroxy-5-naphthalenesulfonic acid]-N'-(2-bromophenyl) urea:  
 N-[2-Hydroxy-4-naphthalenesulfonic acid]-N'-(2-bromophenyl) urea:  
 N-(2-Hydroxy 3-naphthyl) N'-(2-bromo phenyl) urea:  
 N-(2-Hydroxy-1-naphthyl)-N'-(2-bromo phenyl) urea:  
 25 N-(2-Hydroxy-4-nitrophenyl)-N'-(1-naphthyl)urea:

Suitable pharmaceutically acceptable salts are well known to those skilled in the art and include basic salts of inorganic and organic acids, such as hydrochloric acid, hydrobromic acid, sulphuric acid, phosphoric acid, methane sulphonic acid, ethane sulphonic acid, acetic acid, malic acid, tartaric acid, citric acid, lactic acid, oxalic acid, succinic acid, fumaric acid, maleic acid, benzoic acid, salicylic acid, phenylacetic acid and mandelic acid. In addition, pharmaceutically acceptable salts of compounds of Formula (I) may also be formed with a pharmaceutically acceptable cation, for instance, if a substituent group comprises a carboxy moiety. Suitable pharmaceutically acceptable cations are well known to those skilled in the art and include alkaline, alkaline earth, ammonium and quaternary ammonium cations.

The following terms, as used herein, refer to.

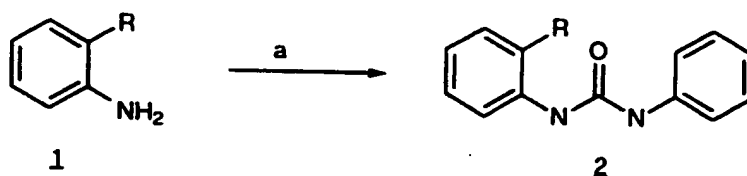
- "halo" - all halogens, that is chloro, fluoro, bromo and iodo.

- "C<sub>1-10</sub>alkyl" or "alkyl" - both straight and branched chain radicals of 1 to 10 carbon atoms, unless the chain length is otherwise limited, including, but not limited to, methyl, ethyl, *n*-propyl, *iso*-propyl, *n*-butyl, *sec*-butyl, *iso*-butyl, *tert*-butyl, *n*-pentyl and the like.
- The term "cycloalkyl" is used herein to mean cyclic radicals, preferably of 3 to 8  
5 carbons, including but not limited to cyclopropyl, cyclopentyl, cyclohexyl, and the like.
- The term "alkenyl" is used herein at all occurrences to mean straight or branched chain radical of 2-10 carbon atoms, unless the chain length is limited thereto, including, but not limited to ethenyl, 1-propenyl, 2-propenyl, 2-methyl-1-propenyl, 1-butenyl, 2-butenyl and the like.
- "aryl" - phenyl and naphthyl;
- "heteroaryl" (on its own or in any combination, such as "heteroaryloxy", or  
10 "heteroaryl alkyl") - a 5-10 membered aromatic ring system in which one or more rings contain one or more heteroatoms selected from the group consisting of N, O or S, such as, but not limited, to pyrrole, pyrazole, furan, thiophene, quinoline, isoquinoline, quinazolinyl, pyridine,  
15 pyrimidine, oxazole, thiazole, thiadiazole, triazole, imidazole, or benzimidazole.
- "heterocyclic" (on its own or in any combination, such as "heterocyclicalkyl") - a saturated or partially unsaturated 4-10 membered ring system in which one or more rings contain one or more heteroatoms selected from the group consisting of N, O, or S; such as, but not limited to, pyrrolidine, piperidine, piperazine, morpholine, tetrahydropyran, or  
20 imidazolidine.
- The term "arylalkyl" or "heteroarylalkyl" or "heterocyclicalkyl" is used herein to mean C<sub>1-10</sub> alkyl, as defined above, attached to an aryl, heteroaryl or heterocyclic moiety, as also defined herein, unless otherwise indicated.
- "sulfinyl" - the oxide S (O) of the corresponding sulfide, the term "thio" refers to the  
25 sulfide, and the term "sulfonyl" refers to the fully oxidized S(O)<sub>2</sub> moiety.
- The term "wherein two R<sub>1</sub> moieties (or two Y moieties) may together form a 5 or 6 membered unsaturated ring" is used herein to mean the formation of a naphthylene ring system or a phenyl moiety having attached a 6 membered partially unsaturated ring such as a C<sub>6</sub> cycloalkenyl, i.e. hexene, or a C<sub>5</sub> cycloalkenyl moiety, cyclopentene.

30

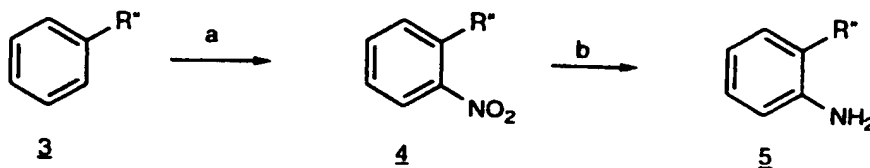
The compounds of Formula (I), (Ia), (Ib), (Ic), (II) and (III) may be obtained by applying synthetic procedures, some of which are illustrated in the Schemes below. The synthesis provided for in these Schemes is applicable for the producing compounds of Formula (I), (Ia), (II) and (III) having a variety of different R, R<sub>1</sub>, and Ar groups which are reacted,  
35 employing optional substituents which are suitably protected, to achieve compatibility with the reactions outlined herein. Subsequent deprotection, in those cases, then affords compounds of the nature generally disclosed. Once the urea nucleus has been established, further compounds

of these formulas may be prepared by applying standard techniques for functional group interconversion, well known in the art. While the schemes are shown with compounds only of Formula (I) this is merely for illustration purposes only.

Scheme 1

R = NH<sub>2</sub>, OH, CO<sub>2</sub>H, SH, NHSO<sub>2</sub>R  
a) PhNCO

Ortho substituted phenyl ureas shown in 2-scheme 1 may be prepared by standard conditions involving the condensation of commercially available ortho substituted aniline (Aldrich Chemical Co., Milwaukee, Wi) with the commercially available optionally substituted aryl isocyanate (Aldrich Chemical Co., Milwaukee, Wi) in an aprotic solvent (DMF, toluene). When the 1-(RSO<sub>2</sub>NH)<sub>2</sub>-(NH<sub>2</sub>)Ph is not commercially available it can be made by treating the commercially available RSO<sub>2</sub>Cl with the corresponding 2-phenylene diamine in the presence of a base like methyl amine or NaH in an aprotic solvent (like methylene chloride or DMF).

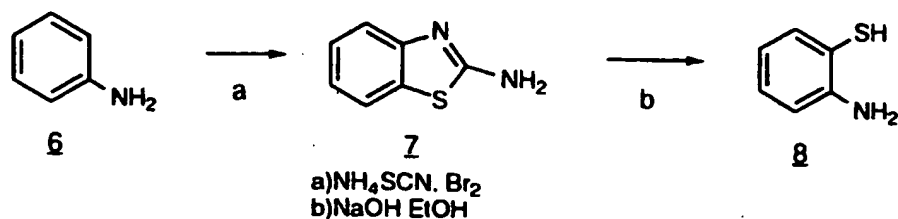
Scheme 2

R\* = OH, NH<sub>2</sub>, NHSO<sub>2</sub>R

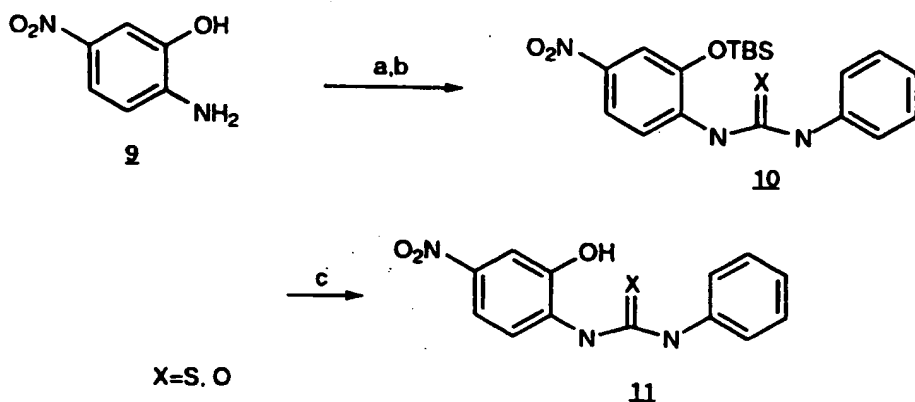
a) HNO<sub>3</sub>, 23 °C b) SnCl<sub>2</sub>, EtOH

If the desired 2-substituted aniline 5-scheme 2 is not commercially available the corresponding nitro compound can be prepared from 3-scheme 2 under standard nitration conditions (using HNO<sub>3</sub> or BF<sub>4</sub>NO<sub>3</sub>) at 23 °C. The nitro compound is then reduced to the corresponding aniline using SnCl<sub>2</sub> in EtOH (or alternately H<sub>2</sub>/Pd or LiAlH<sub>4</sub>).

- 30 -

Scheme 3

If the desired 2-amino benzenethiol 8-scheme 3 is not commercially available it can be synthesized by reaction of the phenyl aniline with the thiocyanate anion in the presence of an oxidant (like bromine) to produce the 2-amino benzthiazole 7-scheme 3. This thiazole can then be hydrolyzed to the desired 2-amino benzenethiol 8-scheme 3 with a strong base like NaOH in a protic solvent (i.e., EtOH).

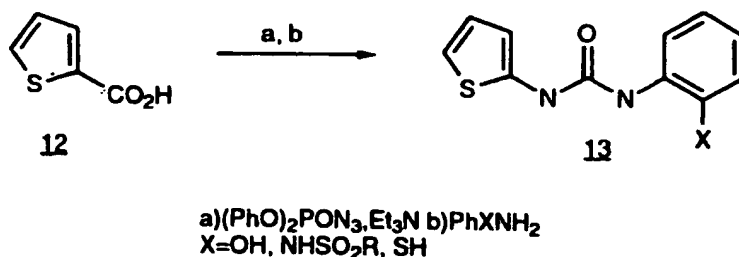
Scheme 4

a) TBSCl, imid, DMF b) i)  $\text{ClCXCl}$ ,  $\text{NaHCO}_3$ , ii)  $\text{PhNH}_2$  c)  $\text{Et}_3\text{N} \cdot \text{HF}$ ,  $\text{CH}_3\text{CN}$

In the case where the thioisocyanate or phenyl isocyanate is not commercially available, the thiourea or urea 11-scheme 4 may be prepared from the commercially available ortho substituted aniline. This compound is first protected with a protecting group (tert-butyl dimethyl silyl or benzyl ) by conditions well known in the art (see Greene, T. Protecting Groups in Organic Synthesis, Wiley & Sons, New York, 1981). This protected aniline is then reacted, in the presence of a base (like triethyl amine or sodium bicarbonate), with either thiophosgene or a solution of phosgene in an aprotic solvent (ie. DMF, toluene), followed by aniline to produce the protected thiourea or urea respectively. The corresponding urea or thiourea is then deprotected, using conditions standard in the art, to form the desired thiourea or urea 11-scheme 4.



Scheme 5

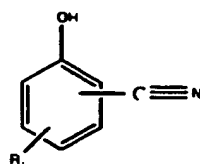


Alternately the urea can be formed using a Curtius rearrangement from the corresponding aromatic or thiophene carboxylic acid 12-scheme 5. The carboxylic acid is submitted to standard Curtius conditions ((PhO)<sub>2</sub>PON<sub>3</sub>, Et<sub>3</sub>N or ClCOCOC<sub>2</sub>H<sub>5</sub> followed by NaN<sub>3</sub>) and the intermediate isocyanate is trapped by an appropriately substituted aniline.

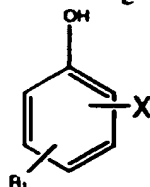
Pharmaceutically acceptable salts of compounds of Formula (I) may be obtained in known manner, for example by treatment thereof with an appropriate amount of acid or base in the presence of a suitable solvent.

Another aspect of the present invention is the novel synthesis of cyano nitrophenol intermediates. Numerous conversions of aryl halides to aryl cyano derivatives with copper (I) cyanide have been published. However, no examples of an aryl ring with a hydroxy group present were mentioned. Several attempts to obtain a cyano phenol moiety with published results failed. Using known conditions of elevated temperatures, greater than 170°C, such as from 180 to 210° did not yield displacement of the halogen to a cyano moiety. Standard bases, such as DMF and pyridine further provided no desired product. Intermediates such as 2-amino-5-fluorophenol, 2-nitro-5-fluorophenol, 2-nitro-5-methyl-6-bromophenol were tried with a change of halogens, from fluorine to chlorine to bromine, and with use of copper (I) cyanide. The use of a bromine derivative, such as 2-nitro-5-methyl-6-bromophenol, with dimethylformamide and using triethylamine with a catalytic amount of dimethylamino pyridine and copper (I) cyanide at reduced temperatures, i.e., <100°C, preferably 60 to about 80°C for reduced times from standardized procedures, i.e., < 18 hours, preferably about 4 to 6 hours yielded the desired products.

Therefore one aspect of the invention is to a process for producing a cyano phenol derivative of the formula:



wherein  $R_1$  is as defined for Formula (I) above, which method comprises reacting a compound of the formula:



wherein X is halogen with copper (I) cyanide, dimethylformamide, triethylamine and a catalytic amount of dimethylamino pyridine. Preferably, the process is run at reduced temperatures of about 60 to about 80°C. Preferably X is bromine.

In the Examples, all temperatures are in degrees Centigrade (°C). Mass spectra were performed upon a VG Zab mass spectrometer using fast atom bombardment, unless otherwise indicated.  $^1\text{H-NMR}$  (hereinafter "NMR") spectra were recorded at 250 MHz or 400 MHz using a Bruker AM 250 or Am 400 spectrometer, respectively. Multiplicities indicated are: s=singlet, d=doublet, t=triplet, q=quartet, m=multiplet and br indicates a broad signal. Sat. indicates a saturated solution, equiv. indicates the proportion of a molar equivalent of reagent relative to the principal reactant.

Flash chromatography is run over Merck Silica gel 60 (230 - 400 mesh).

## SYNTHETIC EXAMPLES

The invention will now be described by reference to the following examples which are merely illustrative and are not to be construed as a limitation of the scope of the present invention. All temperatures are given in degrees centigrade, all solvents used herein are of the highest available purity and all reactions are run under anhydrous conditions in an argon atmosphere unless otherwise indicated.

**General Method A: Synthesis of N, N'- phenyl urea** To a solution of substituted phenyl isocyanate (1.0 equiv.) in toluene (5 mL) the corresponding aniline (1.0 equiv.) was added. The reaction mixture was stirred at about 80°C until complete (24-48 hours (hereinafter "hrs" or "h")), then cooled to room temperature. The purifications, yields and spectral characteristics for each individual compound are listed below.

**General Method B: Synthesis of N, N'- phenyl urea** To a solution of phenyl isocyanate (1.0 equiv.) in dimethyl formamide (1 mL) the corresponding aniline (1.0 equiv.) was added. The reaction mixture was stirred at about 80°C until complete (24-48 hours), then

the solvent was removed under vacuum. The purifications, yields and spectral characteristics for each individual compound are listed below.

**General Method C: Synthesis of sulfonamide** The ortho substituted aniline (1 equiv.), triethyl amine (1 equiv.) and the desired sulfonyl chloride (1 equiv.) were combined in methylene chloride and allowed to stir at about 23 °C until complete (12-36 h). The reaction mixture was partitioned between water and methylene chloride. The organic layer was separated and dried over magnesium sulfate, filtered and concentrated *in vacuo*. The purifications of each compound are listed below.

#### Example 1

##### Preparation of N-[2-Hydroxy-4-(methoxycarbonyl)phenyl]-N'-phenyl urea

N-[2-Hydroxy-4-(methoxycarbonyl)phenyl]-N'-phenyl urea was prepared from methyl-4-amino-3-hydroxybenzoate (200 mg, 1.19 mmol) and phenyl isocyanate (1.19 mmol) according to the procedure noted above in General Method A. The product was purified by precipitation from toluene, and filtering, to afford the titled compound (309 mg, 90%), mp: 188.4-188.8°C: <sup>1</sup>H NMR (CD<sub>3</sub>OD/CDCl<sub>3</sub>): δ 8.15 (d, 1H, J = 8.25 Hz), 7.70 (s, 1H), 7.51 (d, 1H, J = 8.25 Hz), 7.43 (d, 2H, J = 8.25 Hz), 7.30 (t, 2H, J = 8.25 Hz), 7.01 (t, 1H, J = 8.25 Hz), 3.87 (s, 3H); EI-MS m/z 286 (M+H)<sup>+</sup>; Anal. (C<sub>15</sub>H<sub>14</sub>N<sub>2</sub>O<sub>4</sub>) C, H, N.

#### Example 2

##### Preparation of N-[5-nitro-2-hydroxyphenyl]-N'-phenyl urea

The N-[5-nitro-2-hydroxyphenyl]-N'-phenyl urea was prepared from the 5-nitro 2-hydroxy aniline and phenyl isocyanate according to the procedure in General Method A. The product was purified by precipitation from toluene and filtering to afford the titled compound (100 mg, 30%). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 9.48 (s, 1H, NH), 9.07 (d, J = 1.56 Hz, NH), 8.55 (s, 1H), 7.80 (dd, 1H, J = 6.25 Hz and J = 1.56 Hz), 7.50 (d, 2H, J = 6.25 Hz), 7.30 (t, 2H, J = 6.25 Hz), 7.01 (m, 2H). EI-MS m/z 273 (M+H)<sup>+</sup>.

#### Example 3

##### Preparation of 3-hydroxy-4-[(phenylamino)carbonylamino]benzamide

a) Preparation of 0.67 Molar (hereinafter "M") Stock Solutions of Aluminum Amide Reagents

To a suspension of the appropriate hydrochloride (0.02 mole (hereinafter "mol")) in dry toluene (20 mL) at about 0°C, was slowly added a solution of (2M, 10 mL) of trimethyl aluminum in toluene. After the addition was complete, the reaction mixture was allowed to warm to room temperature and was stirred for about 1-2 hours until gas evolution has ceased

b) Preparation of 3-hydroxy-4-[(phenylamino)carbonylamino]benzamide

To a solution of the N-[2-hydroxy-4-(methoxycarbonyl)phenyl]-N'-phenyl urea (60 miligram (hereinafter "mg"), 0.2 mmol) in toluene (2 mL) was added aluminum amide reagent (0.9 mL, 0.67M). The reaction mixture was stirred at reflux for about 12 hours. The reaction mixture was cooled to room temperature and was carefully quenched with 5% HCl. The organic layer was separated and the aqueous layer was extracted three times with ethyl acetate. The organic extracts were combined, dried over MgSO<sub>4</sub>, filtered and concentrated under reduced pressure. Chromatography of the resulting solid on silica gel (ethyl acetate) gave the desired amide (28 mg, 49%). mp: 106.8-107.1°C; <sup>1</sup>H NMR (CD<sub>3</sub>OD/CDCl<sub>3</sub>): δ 7.98 (d, 1H, J = 8.25 Hz), 7.35 (d, 2H, J = 8.25 Hz), 7.30 (d, 2H, J = 8.25 Hz), 7.17 (t, 2H, J = 8.25 Hz), 6.91 (t, 1H, J = 8.25 Hz); EI-MS m/z 271 (M+H)<sup>+</sup>; Anal. (C<sub>14</sub>H<sub>13</sub>N<sub>3</sub>O<sub>3</sub>) C, H, N.

#### Example 4

##### Preparation of N-(2-hydroxy-4-fluorophenyl)-N'-phenyl urea

###### a) Preparation of 2-amino-5-fluoro phenol

A mixture of 5-fluoro-2-nitrophenol (500 mg, 3.18 mmol) and tin (II) chloride (1.76 g, 9.2 mmol) in ethanol (10 mL) was heated at 80°C under argon. After 30 min, the starting material had disappeared and the solution was allowed to cool down and then poured into ice. The pH was made slightly basic (pH 7-8), by addition of 5% aqueous sodium bicarbonate, before being extracted with ethyl acetate. The organic phase was washed with brine, dried over MgSO<sub>4</sub> and filtered. Evaporation of the solvent gave the title compound (335 mg, 83%). <sup>1</sup>H NMR (CD<sub>3</sub>OD/CDCl<sub>3</sub>): δ 6.6 (m, 1H), 6.38 (dd, 1H, J = 8.3 Hz and J = 2.8 Hz), 6.29 (m, 1H).

###### b) Preparation of N-(2-hydroxy-4-fluorophenyl)-N'-phenyl urea

N-(2-Hydroxy-4-fluorophenyl)-N'-phenyl urea was prepared from 2-amino-5-fluoro phenol (200 mg, 1.57 mmol) and phenyl isocyanate according to the procedure in General Method A. The product was purified by precipitation from toluene and filtering to afford the titled compound (352 mg, 91 %). mp: 195.5-195.7°C; <sup>1</sup>H NMR (CD<sub>3</sub>OD/CDCl<sub>3</sub>): δ 7.70 (m, 1H), 7.3 (d, 2H, J = 8.25 Hz), 7.15 (t, 2H, J = 8.25 Hz), 6.89 (t, 1H, J = 8.25 Hz), 6.50 - 6.38 (m, 2H); EI-MS m/z 246 (M+H)<sup>+</sup>; Anal. (C<sub>13</sub>H<sub>11</sub>N<sub>2</sub>O<sub>2</sub> F) C, H, N.

#### Example 5

##### Preparation of 2-[(phenylamino)carbonylamino]thiophenol

2-[(Phenylamino)carbonylamino]thiophenol was prepared from 2-aminothiophenol (200 mg, 1.6 mmol) and phenyl isocyanate according to the procedure in General Method A. The product was purified by precipitation from toluene and filtering to afford the titled compound (330 mg, 85 %). mp: 194.5°C; <sup>1</sup>H NMR (CD<sub>3</sub>OD/CDCl<sub>3</sub>): δ 7.48 - 7.26 (m, 4H), 7.25 - 7.10 (m, 3H), 7.04 - 6.79 (m, 2H); EI-MS m/z 244 (M+H)<sup>+</sup>; Anal. (C<sub>13</sub>H<sub>12</sub>N<sub>2</sub>OS) C, H, N.

Example 6Preparation of N-(2-Carboxy-4-hydroxyphenyl)-N'-phenyl urea

- 5 N-(2-Carboxy-4-hydroxyphenyl)-N'-phenyl urea was prepared from 2-amino-5-hydroxy benzoic acid (1 g, 6.53 mmol) according to the procedure in General Method B. The reaction mixture was partitioned between ethyl acetate and water. The organic phase was washed with brine, dried over  $\text{MgSO}_4$  and filtered. Removal of solvent under reduced pressure and chromatography of the resulting solid on silica gel (hexane : ethyl acetate, 1:1 to 100% ethyl acetate) gave the titled compound (1.5 g, 84%).  $^1\text{H}$  NMR ( $\text{CD}_3\text{OD}/\text{CDCl}_3$ ):  $\delta$  8.36 (d, 1H, J = 8.25 Hz), 7.63 (m, 4H), 7.48 (t, 2H, J = 8.25 Hz), 7.20 (m, 1H); EI-MS m/z 272 (M+H)<sup>+</sup>; Anal. ( $\text{C}_{14}\text{H}_{12}\text{N}_2\text{O}_4$ ) C, H, N.
- 10

Example 7Preparation of N - [2 - hydroxy - 4 - (trifluoromethyl) phenyl] - N' - phenyl urea

- 15 a) Preparation of 2-nitro-5-trifluoromethylphenol
- 2-Nitro-5-trifluoromethylphenol was prepared by adding concentrated  $\text{HNO}_3$  (6 mL) drop-wise to  $\alpha,\alpha,\alpha$ -trifluoro-m-cresol (5g, 30.8 mmol) at room temperature. After the addition was complete the reaction was quenched with saturated ammonium acetate and extracted with EtOAc. The organic was separated, dried over sodium sulfate and filtered.
- 20 Concentration of the solution *in vacuo* afforded an oil which was purified by column chromatography (gradient 100% hexane to 50% EtOAc/hexanes) to afford the titled compound as an oil (1.7 g, 27%).  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ): 10.6 (s, 1H, OH), 8.26 (d, 1H, J = 7.8 Hz), 7.45 (s, 1H, arom), 7.26 (d, 1H, J = 7.8 Hz)
- b) Preparation of 2-amino-5-trifluoromethylphenol
- 25 2-Amino-5-trifluoromethylphenol was prepared by treating 2-nitro-5-trifluoromethylphenol (500 mg, 2.41 mmol) with a solution of  $\text{SnCl}_2$  (3.5g, mmol) in EtOH at 23 °C for 12h. The mixture was concentrated to 50 mL and adjusted to pH 7 using saturated sodium bicarbonate. The reaction mixture was partitioned between  $\text{H}_2\text{O}$  and EtOAc. The aqueous layer was separated and extracted with EtOAc. The combined organic extracts were dried over sodium sulfate, filtered and concentrated *in vacuo*. The resulting colorless oil (370 mg, 87%) was used without further purification.  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ): 7.6 (s, 1H), 7.39 (d, 1H, J = 8.5 Hz), 7.08 (d, 1H, J = 8.5 Hz)
- 30 c) Preparation of N - [2 - hydroxy - 4 - (trifluoromethyl) phenyl] - N' - phenyl urea
- N - [2 - Hydroxy - 4 - (trifluoromethyl) phenyl] - N' - phenyl urea was prepared from 2-amino-5-trifluoromethylphenol (150 mg, 1.09 mmol) and phenyl isocyanate (1.09 mmol) according to the procedure in General method A. The product was purified by precipitation from methylene chloride and filtering to afford the titled compound ( 230 mg, 87% ). mp: °C:  $^1\text{H}$  NMR ( $\text{DMSO}-d_6$ ):  $\delta$  9.45 (s, 1H, NH), 8.50 (s, 1H, NH), 8.31 (d, 1H, J = 10.0 Hz).

7.45 (d, 2H,  $J = 10.0$  Hz), 7.29 (t, 2H,  $J = 6.67$  Hz), 7.10 (m, 2H), 6.99 (t, 1H,  $J = 6.67$  Hz). EI-MS  $m/z$  296 ( $M^+$ ). Anal. ( $C_{14}H_{11}N_2O_2F_3$ )C, H, N.

### Example 8

#### 5 Preparation of N-(2-hydroxy-4-nitrophenyl)-N'-(2-hydroxy-4-nitrophenyl) urea

##### a) Preparation of 2-(*tert*-butyldimethylsilyloxy)-4-nitroaniline

To a solution of 2-amino-5-nitrophenol (1 g, 6.49 mmol) and imidazole (0.88 g, 12.3 mmol) in DMF (15 mL), *tert*-butyldimethylsilyl chloride (11.2 mL, 64.9 mmol) was added.

- 10 The resulting mixture was allowed to stir at 23°C for 48 hours. The reaction mixture was partitioned between 0.1 % HCl and ethyl acetate. The combined organic phase was washed with brine, dried over  $MgSO_4$  and filtered. Removal of solvent at reduced pressure and chromatography of the resulting oil on silica gel (hexane : ethyl acetate: 5:1) gave the titled compound (1.7 g, 98 %).  $^1H$  NMR ( $CDCl_3$ ):  $\delta$  7.78 (dd, 1H,  $J = 6.7$  Hz and  $J = 2.7$  Hz),
- 15 7.61 (d, 1H,  $J = 2.7$  Hz), 6.7 (d, 1H,  $J = 8.8$  Hz), 1.0 (s, 9H), 0.28 (s, 6H).

##### b) Preparation of N-[(2-*tert*-butyldimethylsilyloxy)-4-nitrophenyl]-N'-[(2-*tert*-butyldimethylsilyloxy)-4-nitrophenyl] urea

To a solution of 2-(*tert*-butyldimethylsilyloxy)-4-nitroaniline (200 mg, 0.75 mmol) in toluene (10 mL) triethylamine (0.13 mL, 1.64 mmol) and triphosgene (88.4 mg, 0.3 mmol)

20 were added. The reaction mixture was stirred at 70°C for 2 hours, then cooled to room temperature. Then more 2-(*tert*-butyldimethylsilyloxy)-4-nitroaniline (200 mg, 0.75 mmol) was added. The resulting mixture was allowed to stir at 70°C for 48 hours then cooled to room temperature. The reaction mixture was partitioned between water and ethyl acetate. The combined organic phase was washed with brine, dried over  $MgSO_4$  and filtered. Removal of

25 solvent at reduced pressure and chromatography of the resulting oil on silica gel (hexane : ethyl acetate, 10:1) gave the titled compound (130 mg, 31 %).  $^1H$  NMR ( $CDCl_3$ ):  $\delta$  8.36 (d, 2H,  $J = 8.3$  Hz), 7.90 (dd, 2H,  $J = 8.3$  Hz and  $J = 2.8$  Hz), 7.71 (d, 2H,  $J = 2.8$  Hz), 7.22 (s, 2H), 1.02 (s, 18H), 0.35 (s, 12H).

##### c) Preparation of N-(2-Hydroxy-4-nitrophenyl)-N'-(2-hydroxy-4-nitrophenyl) urea

- 30 To a solution of N-[(2-*tert*-butyldimethylsilyloxy)-4-nitrophenyl]-N'-[(2-*tert*-butyldimethylsilyloxy)-4-nitrophenyl] urea (50 mg, 0.089 mmol) in THF (2 mL), tetrabutylammonium fluoride (1 M, 0.09 mL, 0.089 mmol) was added at 0°C. The reaction mixture was stirred at 23°C. After 1 hour, the starting material had disappeared. The reaction mixture was partitioned between water and ethyl acetate. The combined organic phase was
- 35 dried over  $MgSO_4$  and filtered. Removal of solvent at reduced pressure and chromatography of the resulting oil on silica gel (hexane : ethyl acetate: 1:1 to 100% ethyl acetate) gave the titled compound (24 mg, 81 %).  $^1H$  NMR ( $CD_3OD/CDCl_3$ ):  $\delta$  8.32 (d, 2H,  $J = 8.25$  Hz), 7.80 (dd,

2H,  $J = 8.25$  Hz and  $J = 2.06$  Hz), 7.7 (d, 2H,  $J = 2.06$  Hz). EI-MS  $m/z$  334 ( $M+H$ )<sup>+</sup>. Anal. ( $C_{13}H_{10}N_4O_7$ ) C, H, N.

### Example 9

#### 5 Preparation of N-(2-hydroxy-4-nitrophenyl)-N'-phenyl-thiourea

##### a) Preparation of N-(2-tert-butyldimethylsilyloxy-4-nitrophenyl)-N'-phenyl-thiourea

N-(2-tert-Butyldimethylsilyloxy-4-nitrophenyl)-N'-phenyl-thiourea was prepared by treating a biphasic solution of 2-tert-butyldimethylsilyloxy-4-nitroaniline (80 mg, 0.308 mmol) and  $NaHCO_3$  in  $CHCl_3:H_2O$  (2.5:1, 7 mL) with thiophosgene at 0°C. The solution was allowed  
10 to warm to 23°C and the reaction was continued overnight. The  $CHCl_3$  layer was separated and dried over sodium sulfate. The solution was concentrated *in vacuo* and the residue was dissolved in toluene and treated with aniline (100  $\mu$ L) at 23 °C for 12 h. The reaction mixture was concentrated and the residue was purified by flash chromatography (10% EtOAc/hexanes) to afford the titled compound as a yellow solid (120.8 mg, 98%) mp: 144-145°C:  $^1H$  NMR ( $CD_3OD/CDCl_3$ ):  $\delta$  8.65 (d, 1H,  $J = 10.0$  Hz), 7.58 (d, 1H,  $J = 10.0$  Hz), 7.47 (d, 1H,  $J = 1.25$  Hz), 7.26 (m, 4H), 7.10 (m, 1H).  
15

##### b) Preparation of N-(2-hydroxy-4-nitrophenyl)-N'-phenyl-thiourea

N-(2-Hydroxy-4-nitrophenyl)-N'-phenyl-2-thiourea was prepared by treating a solution of N-(2-tert-butyldimethylsilyloxy-4-nitrophenyl)-N'-phenyl-thiourea (100 mg, 0.248 mmol) in  $CH_3CN$  (1 mL) with  $Et_3N \cdot HF$  (100  $\mu$ L, 0.62 mmol) in acetonitrile for 10 minutes at 23°C. The solution was concentrated and flushed through a silica plug with EtOAc to afford the desired compound as an orange solid (55 mg, 77%).  
20 mp: 144-145°C:  $^1H$  NMR ( $CD_3OD/CDCl_3$ ):  $\delta$  8.65 (d, 1H,  $J = 10.0$  Hz), 7.58 (d, 1H,  $J = 10.0$  Hz), 7.47 (d, 1H,  $J = 1.25$  Hz), 7.26 (m, 4H), 7.10 (m, 1H).  
25

### Example 10

#### Preparation of N-(4-nitro 2-(phenylsulfonylamino)phenyl)-N'-phenyl urea

##### a) Preparation of 4-nitro 2-(phenylsulfonylamino) aniline

A solution of 4-nitro 1,2-phenylene diamine (1.53 g, 10.0 mmol) in DMF was treated with phenyl sulfonyl chloride (1.76 g, 10.0 mmol) and triethyl amine (1.01 g) in DMF for 12 h at 23 °C. The reaction mixture was partitioned between saturated  $NH_4Cl$  and methylene chloride. The organic layer was dried over sodium sulfate, filtered and concentrated *in vacuo*. The resulting solid was recrystallized (EtOH) to afford desired (0.275 g, 9%).  $^1H$  NMR(DMSO) 9.5(s, 1H, br), 7.83 (dd, 1H,  $J=10$  Hz, 2 Hz), 7.74(d, 2H,  $J=8$  Hz), 7.76(t, 1H,  $J=8$  Hz), 7.56(t, 2H,  $J=8$  Hz), 7.55(d, 1H,  $J=2$ Hz), 6.79 (d, 1H,  $J=8$ Hz), 6.5(s, 2H, br)  
30  
35

##### b) Preparation of N-(4-nitro 2-(phenylsulfonylamino)phenyl)-N'-phenyl urea

- 38 -

N-(4-Nitro 2-(phenylsulfonylamino)phenyl)-N'-phenyl urea was prepared from 4-nitro 2-(phenylsulfonylamino) aniline(82 mg) and phenyl isocyanate(33 mg) by method A. The reaction was cooled and then partitioned between saturated ammonium chloride and 9:1 methylene chloride and methanol. The organic phase was dried over magnesium sulfate.

- 5 filtered and concentrated *in vacuo*. The residue was purified by column chromatography (ethyl acetate/hexanes) to afford desired(30.8 mg, 26%). EI-MS m/z 413(M+H)<sup>+</sup>

### Example 11

#### Preparation of N-(2-hydroxy-5-nitrophenyl)-N'-(3-methoxy-2-thienyl)urea

- 10 a)Preparation of 3-methoxy-2-thienylcarboxylic acid

To a solution of 3-methoxythiophene (4.81 g, 42.1 mmol) in ether (20 mL) at -78°C, butyllithium (17 mL, 47.6 mmol) was added. The reaction mixture was stirred at -78°C for 1 hour, then it was warmed to 0°C for 3 hours. After to recooling -78°C the reaction mixture was poured into a beaker filled with crushed dry ice (14.5 g) and allowed to stand until the excess dry ice had completely sublimed. Then the reaction mixture was poured into a mixture of ice (10 g) to which conc. HCl (24 mL) had been added. The product was purified by precipitation from ether and filtering (6.42 g, 96 %). EI-MS m/z 159 (M+H)<sup>+</sup>.

- 15 b)Preparation of N-(2-hydroxy-5-nitrophenyl)-N'-(3-methoxy-2-thienyl)urea

To a solution of 3-methoxy-2-thiophene carboxylic acid (200 mg, 1.27 mmol) in benzene, (PhO)<sub>2</sub>PON<sub>3</sub> (0.33 mL), 2-amino-4-nitrophenol (195.7 mg, 1.27 mmol) and triethylamine (1.1 equiv., 0.25 mL) were added. The reaction mixture was stirred at reflux overnight. The reaction mixture was partitioned between 5% citric acid and ethyl acetate. The organic layer was separated and the aqueous layer was extracted three times with ethyl acetate. The organic extracts were combined, dried over MgSO<sub>4</sub>, filtered and concentrated under reduced pressure. Chromatography of the resulting solid on silica gel (hexane:ethyl acetate:1:1) gave a solid product (160 mg, 41%). mp: 172.6-173.0°C; <sup>1</sup>H NMR (CD<sub>3</sub>OD/CDCI<sub>3</sub>): δ 8.96 (d, 1H, J = 2.5 Hz), 7.74 (dd, 1H, J = 5.0 Hz and J = 1.25 Hz), 6.82 (d, 1H, J = 7.5 Hz), 6.76 (s, 2H), 3.80 (s, 3H); EI-MS m/z 309 (M+H)<sup>+</sup>; Anal. (C<sub>12</sub>H<sub>11</sub>N<sub>3</sub>O<sub>5</sub>S) C, H, N.

30

### Example 12

#### Preparation of N-(2-hydroxy-4-nitrophenyl)-N'-(3-methoxy-2-thienyl)urea

To a solution of 3-methoxy-2-thiophene carboxylic acid (example 11a, 200 mg, 1.27 mmol) in toluene, (PhO)<sub>2</sub>PON<sub>3</sub> (0.33 mL) and triethylamine (1.1 equiv., 0.25 mL) were added. The reaction mixture was stirred at 70°C for 2 hours and cooled down to room temperature then 2-amino-5-nitrophenol was added. The reaction mixture was stirred at 70°C overnight. The reaction mixture was partitioned between 5% citric acid and ethyl acetate. The organic layer was separated and the aqueous layer was extracted three times with ethyl acetate.

35



The organic extracts were combined, dried over  $\text{MgSO}_4$ , filtered and concentrated under reduced pressure. Chromatography of the resulting solid on silica gel (hexane:ethyl acetate:1:1) gave the product (190 mg, 48%).  $^1\text{H}$  NMR ( $\text{CD}_3\text{OD}/\text{CDCl}_3$ ):  $\delta$  8.38 (d, 1H,  $J = 5.0$  Hz), 7.85 (dd, 1H,  $J = 5.0$  Hz and  $J = 1.25$  Hz), 7.76 (d, 1H,  $J = 2.5$  Hz), 6.9 (s, 2H),

5 3.95 (s, 3H); EI-MS  $m/z$  309 ( $\text{M}+\text{H}$ ) $^+$ ; Anal. ( $\text{C}_{12}\text{H}_{11}\text{N}_3\text{O}_5\text{S}$ ) C, H, N.

#### Example 13

##### Preparation of N-(2-hydroxy-4-nitrophenyl)-N'-(3-methoxyphenyl)urea

N-(2-Hydroxy-4-nitrophenyl)-N'-(3-methoxyphenyl)urea was prepared from 2-hydroxy 4-nitro aniline (154 mg, 1.0 mmol) and 3-methoxy phenyl isocyanate (1.0 mmol) according to the procedure in General Method B. The product was purified by dilution with methylene chloride and precipitation with hexanes. Filtering afforded the title compound (140 mg, 46%). EI-MS  $m/z$  302 ( $\text{M}-\text{H}$ ) $^-$

#### Example 14

##### 15 Preparation of N-(2-hydroxy-4-nitrophenyl)-N'-(2-methoxyphenyl)urea

N-(2-Hydroxy-4-nitrophenyl)-N'-(2-methoxyphenyl)urea was prepared from 2-hydroxy 4-nitro aniline (154 mg, 1.0 mmol) and 2-methoxy phenyl isocyanate (1 mmol) according to the procedure in General Method B. The product was purified by dilution with methylene chloride and precipitation with hexanes. Filtering afforded the title compound (82 mg, 27%). EI-MS  $m/z$  302 ( $\text{M}-\text{H}$ ) $^-$

#### Example 15

##### Preparation of N-(2-hydroxy-4-nitrophenyl)-N'-(3-trifluoromethylphenyl)urea

N-(2-Hydroxy-4-nitrophenyl)-N'-(3-methoxyphenyl)urea was prepared from 2-hydroxy 4-nitro aniline (154 mg, 1.0 mmol) and 3-trifluoromethyl phenyl isocyanate (1 mmol) according to the procedure in General Method B. The product was purified by dilution with methylene chloride and precipitation with hexanes. Filtering afforded the title compound (180 mg, 52%). EI-MS  $m/z$  342 ( $\text{M}+\text{H}$ ) $^+$

#### Example 16

##### 30 Preparation of N-(2-hydroxy-4-nitrophenyl)-N'-(2-trifluoromethylphenyl)urea

N-(2-Hydroxy-4-nitrophenyl)-N'-(2-trifluoromethylphenyl)urea was prepared from 2-hydroxy 4-nitro aniline (154 mg, 1.0 mmol) and 2-trifluoromethyl phenyl isocyanate (1.0 mmol) according to the procedure in General Method B. The product was purified by dilution with methylene chloride and precipitation with hexanes. Filtering afforded the title compound (180 mg, 52%). EI-MS  $m/z$  342 ( $\text{M}+\text{H}$ ) $^+$

#### Example 17

##### Preparation of N-(2-hydroxy-4-nitrophenyl)-N'-(4-trifluoromethylphenyl)urea

- 40 -

N-(2-Hydroxy-4-nitrophenyl)-N'-(4-trifluoromethylphenyl)urea was prepared from 2-hydroxy 4-nitro aniline (154 mg, 1.0 mmol) and 4-trifluoromethyl phenyl isocyanate (1.0 mmol) according to the procedure in General Method B. The product was purified by dilution with methylene chloride and precipitation with hexanes. Filtering afforded the title compound (111 mg, 32%). EI-MS m/z 340(M-H)<sup>-</sup>

#### Example 18

##### Preparation of N-(2-hydroxy-4-nitrophenyl)-N'-(2-bromophenyl)urea

N-(2-Hydroxy-4-nitrophenyl)-N'-(2-bromophenyl)urea was prepared from 2-hydroxy 4-nitro aniline (500 mg, 3.24 mmol) and 2-bromophenyl isocyanate (3.24 mmol) according to the procedure in General Method B. The product was purified by dilution with methylene chloride and precipitation with hexanes. Filtering afforded the title compound (530 mg, 47%). EI-MS m/z 350(M-H)<sup>-</sup>

#### Example 19

##### Preparation of N-(2-hydroxy-4-nitrophenyl)-N'-(3-bromophenyl)urea

N-(2-Hydroxy-4-nitrophenyl)-N'-(3-bromo phenyl)urea was prepared from 2-hydroxy 4-nitro aniline (500 mg, 3.24 mmol) and 3-bromo phenyl isocyanate (3.24 mmol) according to the procedure in General Method B. The product was purified by dilution with methylene chloride and precipitation with hexanes. Filtering afforded the title compound (0.96 g, 87%). EI-MS m/z 350(M-H)<sup>-</sup>

#### Example 20

##### Preparation of N-(2-hydroxy-4-nitrophenyl)-N'-(4-bromophenyl)urea

N-(2-Hydroxy-4-nitrophenyl)-N'-(4-bromo phenyl)urea was prepared from 2-hydroxy 4-nitro aniline (500 mg, 3.24 mmol) and 4-bromo phenyl isocyanate (3.24 mmol) according to the procedure in General Method B. The product was purified by dilution with methylene chloride and precipitation with hexanes. Filtering afforded the title compound (0.41 g, 37%). EI-MS m/z 352(M+H)<sup>+</sup>

#### Example 21

##### Preparation of N-(2-hydroxy-4-nitrophenyl)-N'-(2-phenylphenyl)urea

N-(2-Hydroxy-4-nitrophenyl)-N'-(2-phenylphenyl)urea was prepared from 2-hydroxy 4-nitro aniline (500 mg, 3.24 mmol) and 2-phenyl phenyl isocyanate (3.24 mmol) according to the procedure in General Method B. The product was purified by dilution with methylene chloride and precipitation with hexanes. Filtering afforded the title compound (0.22 g, 19%). EI-MS m/z 350(M+H)<sup>+</sup>

#### Example 22

Preparation of N-(2-hydroxy-4-nitrophenyl)-N'-(1-naphthyl)urea

N-(2-Hydroxy-4-nitrophenyl)-N'-(1-naphthyl)urea was prepared from 2-hydroxy 4-nitro aniline (500 mg, 3.24 mmol) and 1-naphthyl isocyanate (3.24 mmol) according to the procedure in General Method B. The product precipitated from methylene chloride and filtered.  
5 The resulting solid was titrated with 1:3 triethyl amine:methylene chloride. The filtrate was concentrated *in vacuo*. The resulting residue was dissolved in methylene chloride and treated with 1N HCl in water. The desired product precipitated from solution and was collected by filtration (0.11 g, 10%). EI-MS m/z 324(M+H) +

Example 23

Preparation of N-(2-hydroxy-4-nitrophenyl)-N'-(2-nitrophenyl)urea

N-(2-Hydroxy-4-nitrophenyl)-N'-(2-nitro phenyl)urea was prepared from 2-hydroxy 4-nitro aniline (500 mg, 3.24 mmol) and 2-nitro phenyl isocyanate (3.24 mmol) according to the procedure in General Method B. The product was purified by dilution with methylene  
15 chloride and precipitation with hexanes. Filtering afforded the title compound (0.44 g, 44%). EI-MS m/z 319(M+H) +

Example 24

Preparation of N-(2-hydroxy-4-nitrophenyl)-N'-(2-fluorophenyl)urea

20 N-(2-Hydroxy-4-nitrophenyl)-N'-(2-fluorophenyl)urea was prepared from 2-hydroxy 4-nitro aniline (500 mg, 3.24 mmol) and 2-fluoro phenyl isocyanate (3.24 mmol) according to the procedure in General Method B. The product was purified by dilution with methylene chloride and precipitation with hexanes. Filtering afforded the title compound (0.59 g, 31%). EI-MS m/z 292(M+H) +

Example 25

Preparation of N-(2-hydroxy-4-nitrophenyl)-N'-(2,6-difluorophenyl)urea

25 N-(2-Hydroxy-4-nitrophenyl)-N'-(2,6-difluorophenyl)urea was prepared from 2-hydroxy 4-nitro aniline (500 mg, 3.24 mmol) and 2,6-difluoro phenyl isocyanate (3.24 mmol) according to the procedure in General Method B. The product was purified by dilution with methylene chloride and precipitation with hexanes. Filtering afforded the title compound (0.91 g, 91%). EI-MS m/z 308(M-H) -

Example 26

Preparation of N-(2-hydroxy-4-nitrophenyl)-N'-(2-ethoxyphenyl)urea

35 N-(2-Hydroxy-4-nitrophenyl)-N'-(2-ethoxyphenyl)urea was prepared from 2-hydroxy 4-nitro aniline (500 mg, 3.24 mmol) and 2-ethoxy phenyl isocyanate (3.24 mmol) according to the procedure in General Method B. The product was purified by dilution with methylene chloride and precipitation with hexanes. Filtering afforded the title compound (0.84 g, 81%). EI-MS m/z 318(M+H) +

Example 27Preparation of N-(2-hydroxy-4-nitrophenyl)-N'-(2-ethylphenyl)urea

N-(2-Hydroxy-4-nitrophenyl)-N'-(2-ethylphenyl)urea was prepared from 2-hydroxy 4-nitro aniline (500 mg, 3.24 mmol) and 2-ethyl phenyl isocyanate (3.24 mmol) according to the procedure in General Method B. The product was purified by dilution with methylene chloride and precipitation with hexanes. Filtering afforded the title compound(0.44 g, 43%). EI-MS m/z 302(M+H) +

Example 28

10 Preparation of N-(2-hydroxy-4-nitro phenyl)-N'-(2-trifluoromethoxyphenyl)urea

N-(2-Hydroxy-4-nitrophenyl)-N'-(2-trifluoromethoxyphenyl)urea was prepared from 2-hydroxy 4-nitro aniline (500 mg, 3.24 mmol) and 2-trifluoromethoxy phenyl isocyanate (3.24 mmol) according to the procedure in General Method B. The product was purified by dilution with methylene chloride and precipitation with hexanes. Filtering afforded the title compound(0.69 g, 60%). EI-MS m/z 358(M+H) +

Example 29Synthesis of N-(2-hydroxy-4-nitro phenyl) N'-(2-methylthio phenyl) urea

The urea was prepared from 2-hydroxy 4-nitro aniline (500 mg, 3.24 mmol) and 2-methylthio phenyl isocyanate(3.24 mmol) by general Method B. The product was purified by dilution with methylene chloride and precipitation with hexanes. Filtering afforded the title compound(0.63 g, 61%). EI-MS m/z 320(M+H) +

Example 30

25 Synthesis of N-(2-hydroxy-4-nitro phenyl) N'-(2-chloro 6-methyl phenyl) urea

The urea was prepared from 2-hydroxy 4-nitro aniline (500 mg, 3.24 mmol) and 2-chloro 6-methyl phenyl isocyanate by general Method B. It was purified by dilution with methylene chloride and precipitation with hexane. Filtering afforded the desired compound(0.31 g, 29%). EI-MS m/z 322(M+H) +

30

Example 31Synthesis of N-(2-hydroxy-4-nitro phenyl) N'-(2-methyl sulfoxoxyphenyl) urea

The urea was synthesized by treatment of N-(2-hydroxy 4-nitro phenyl) N'-(2-methyl thio phenyl) urea(example 28, 100 mg) with sodium periodate(100 mg) in t-butanol/water for 12 hours at 23 °C. The product precipitated from the reaction mixture(30 mg, 29%). EI-MS m/z 336(M+H) +

35

Example 32

Synthesis of N-(2-hydroxy 4-trifluoromethyl phenyl) N'-(2-bromo phenyl) urea

The urea was prepared from 2-hydroxy 4-trifluoromethyl aniline(example 7a, 0.171 g, 1 mmol) and 2-bromo phenyl isocyanate(1 mmol) by general Method B. It was purified by dilution with methylene chloride and precipitation with hexane. Filtering afforded the desired compound(0.25 g, 54%). EI-MS m/z 375(M+H)<sup>+</sup>

Example 33Synthesis of N-(2-hydroxy 4-carbomethoxy phenyl) N'-(2-bromo phenyl) urea

The urea was prepared from 2-hydroxy 4-carbomethoxy aniline(0.167 g, 1 mmol) and 2-bromo phenyl isocyanate(1 mmol) by general Method B. It was purified by dilution with methylene chloride and precipitation with hexane. Filtering afforded the desired compound(0.12 g, 33%). EI-MS m/z 363(M-H)<sup>-</sup>

Example 34Synthesis of N-(2-hydroxy 4-trifluoromethyl phenyl) N'-(2-phenyl phenyl) urea

The urea was prepared from 2-hydroxy 4-trifluoromethyl aniline(example 7a, 0.171 g, 1 mmol) and 2-phenyl phenyl isocyanate by general Method B. It was purified by dilution with methylene chloride and precipitation with hexane. Filtering afforded the desired compound(0.24 g, 64%). EI-MS m/z 373(M+H)<sup>+</sup>

Example 35Synthesis of N-(2-hydroxy 4-carbomethoxy phenyl) N'-(2-phenyl phenyl) urea

The urea was prepared from 2-hydroxy 4-carbomethoxy aniline(0.167 g, 1 mmol) and 2-phenyl phenyl isocyanate(1 mmol) by general Method B. It was purified by dilution with methylene chloride and precipitation with hexane. Filtering afforded the desired compound(0.185 g, 50%). EI-MS m/z 363(M-H)<sup>-</sup>

Example 36Synthesis of N-(2-hydroxy 4-nitro phenyl) N'-(2,3-dichloro phenyl) urea

The urea was prepared from 2-hydroxy 4-nitro aniline(308 mg, 2 mmol) and 2,3-dichloro phenyl isocyanate(2 mmol) by general Method B. It was purified by dilution with methylene chloride and precipitation with hexane. Filtering afforded the title compound(0.5 g, 73%). EI-MS m/z 342(M+H)<sup>+</sup>

Example 37Synthesis of N-(2-hydroxy 4-nitro phenyl) N'-(2,4-dichloro phenyl) urea

- 44 -

The urea was prepared from 2-hydroxy 4-nitro aniline(308 mg, 2 mmol) and 2,4-dichloro phenyl isocyanate(2 mmol) by general Method B. It was purified by dilution with methylene chloride and precipitation with hexane. Filtering afforded the title compound(0.26 g, 38%). EI-MS m/z 342 (M+H)<sup>+</sup>

5

#### Example 38

##### Synthesis of N-(2-hydroxy-4-nitro phenyl) N'-(2-chloro phenyl) urea

The urea was prepared from 4-nitro 2-hydroxy aniline(308 mg, 2 mmol) and 2-chloro phenyl isocyanate(2 mmol) by general Method B. It was purified by dilution with methylene chloride and precipitation with hexane. Filtering afforded the title compound(0.29 g, 47%). EI-MS m/z 308(M+H)<sup>+</sup>

10

#### Example 39

##### Synthesis of N-(2-hydroxy-4-nitrophenyl) N'-(2,4-dibromo phenyl) urea

The urea was prepared from 4-nitro 2-hydroxy aniline(308 mg, 2 mmol) and 2,4-dibromo phenyl isocyanate(2 mmol) by general Method B. It was purified by dilution with methylene chloride and precipitation with hexane. Filtering afforded the title compound(0.34 g, 39%). EI-MS m/z 430(M+H)<sup>+</sup>

15

#### Example 40

##### Synthesis of N-(2-hydroxynaphthyl) N'-(2-bromo phenyl) urea

The urea was prepared from 1-amino 2-hydroxy naphthalene(195 mg, 1 mmol) and 2-bromo phenyl isocyanate(1 mmol) by general Method B. It was purified by dilution with methylene chloride and precipitation with hexane. Filtering afforded the title compound(0.030 g, 8%). EI-MS m/z 357(M+H)<sup>+</sup>

20

25

#### Example 41

##### Synthesis of N-(2-hydroxy-4-nitrophenyl)-N'-(2,3-methylenedioxyphenyl)urea

##### 30 a) Preparation of 2,3-methylenedioxyphenylcarboxylic acid

A solution of 1,3-benzodioxole (3.09 g, 32 mmol) in dry ether (50 mL) was treated dropwise at -10°C with 2.5 M n-butyllithium (15 mL, 35 mmol) in hexane. When the addition was complete, the mixture was stirred under reflux for one hour. After cooling to room temperature, it was added to crushed solid carbon dioxide, and after 24 hours, the residue was treated with 10 % aq. NaHCO<sub>3</sub> and ether. The alkali layer was separated, washed with ether, then acidified with cold concentrated HCl, and extracted with chloroform. The combined

35

organic layers were dried over  $\text{MgSO}_4$ , filtered and concentrated under reduced pressure (1.1 g, 20 %). EI-MS  $m/z$  167 ( $\text{M}+\text{H}$ )<sup>+</sup>

b) Preparation of N-(2-hydroxy-4-nitrophenyl)-N'-(2,3-methylenedioxyphenyl)urea

To a solution of the 2,3-methylenedioxyphenylcarboxylic acid in toluene, triethylamine (0.27 mL, 1.95 mmol) and diphenylphosphoryl azide (DPPA) (0.32 mL, 1.5 mmol) were added. The reaction mixture was stirred at 60°C for 2 hours, then 2-amino-5-nitrophenol (250 mg, 1.5 mmol) was added. The reaction mixture was stirred at 100°C for 18 hours. After the reaction mixture was cooled to room temperature, it was partitioned between 5 % citric acid and ethyl acetate. The organic layer was separated and the aqueous layer was extracted three times with ethyl acetate. The organic extracts were combined, dried over  $\text{MgSO}_4$ , filtered and concentrated under reduced pressure. Chromatography of the resulting solid on silica gel (hexane : ethyl acetate; 5:1) gave product (200 mg, 42 %). EI-MS  $m/z$  318 ( $\text{M}+\text{H}$ )<sup>+</sup>

Example 42

Synthesis of N-(2-hydroxy 4-nitro phenyl) N'-(2-methoxy 3-chloro phenyl) urea

The urea was prepared from 2-hydroxy 4-nitro aniline (308 mg, 2 mmol) and 2-chloro 3-methoxy phenyl isocyanate (2 mmol) by general Method B. It was purified by dilution with methylene chloride and precipitation with hexane. Filtering afforded the title compound (0.48 g, 63%). EI-MS  $m/z$  338 ( $\text{M}+\text{H}$ )<sup>+</sup>

Example 43

Synthesis of N-(2-hydroxy 4-nitro phenyl) N'-(2-methyl phenyl) urea

The urea was prepared from 2-hydroxy 4-nitro aniline (308 mg, 2 mmol) and 2-methyl phenyl isocyanate (2 mmol) by general Method B. It was purified by dilution with methylene chloride and precipitation with hexane. Filtering afforded the title compound (0.38 g, 53%). EI-MS  $m/z$  288 ( $\text{M}+\text{H}$ )<sup>+</sup>

Example 44

Synthesis of N(bis (2-hydroxy 4-nitro phenyl) N'-(dianisidine) diurea

The urea was prepared from 2-hydroxy 4-nitro aniline (616 mg, 4 mmol) and dianisidine diisocyanate (2 mmol) by general Method B (except 2 equiv. of 4-nitro 2-hydroxy aniline was used instead of 1 equiv.). The product was purified by dilution with methylene chloride and precipitation with hexane. Filtering afforded the title compound (0.08 g, 6%). EI-MS  $m/z$  605 ( $\text{M}+\text{H}$ )<sup>+</sup>

Example 45

Synthesis of 4-methylene bis(N-(2-chloro phenyl) N'-(2-hydroxy 4-nitro phenyl) urea)

- 46 -

The urea was prepared from 2-hydroxy 4-nitro aniline(616 mg, 4 mmol) and 4-methylene bis(N-(2-chloro phenyl) diisocyanate(2 mmol) by general Method B(except 2 equiv. of 4-nitro 2-hydroxy aniline was used instead of 1equiv.). The product was purified by dilution with methylene chloride and precipitation with hexane. Filtering afforded the title compound(0.10 g, 8%).

5 EI-MS m/z 627(M+H)<sup>+</sup>

#### Example 46

##### Synthesis of N-[2-hydroxy 4-(benzylamino)carbonyl phenyl]-N'-(2-bromophenyl)urea

##### 10 a)Synthesis of N-(2-hydroxy 4-carboxylate phenyl) N'-(2-bromo phenyl) urea

The urea was prepared from 3-hydroxy 4-amino benzoic acid (3.69 g, 24 mmol) and 2-bromo phenyl isocyanate(24 mmol) by general Method B. It was purified by dilution of the DMF solution with methylene chloride and precipitation with hexane(4.0 g, 48%). EI-MS m/z 351(M+H)<sup>+</sup>

##### 15 b)Preparation of N-[4-(benzylamino)carbonyl-2-hydroxyphenyl]-N'-(2-bromophenyl)urea

To a solution of the N-(2-hydroxy 4-carboxylate phenyl) N'-(2-bromo phenyl) urea (200 mg, 0.58 mmol) in DMF (15 mL), EDC (121.9 mg, 0.58 mmol), HOBT (156.6 mg, 11.6 mmol) were added. The reaction mixture was stirred at room temperature for 16 hours. Then the benzyl amine (123 mg, 11.6 mmol) was added. The reaction mixture was stirred at same temperature for 24 hours. Then the reaction mixture was partitioned between water and ethyl acetate. The organic layer was separated and the aqueous layer was extracted three times with ethyl acetate. The organic extracts were combined, dried over MgSO<sub>4</sub>, filtered and concentrated under reduced pressure. Chromatography of the resulting solid on silica gel (hexane : ethyl acetate; 1:1) gave benzylamino product (500 mg, 65 %). EI-MS m/z 441 (M+H)<sup>+</sup>

25

#### Example 47

Synthesis of N-(2-hydroxy 4-nitro phenyl) N'-(2-phenoxy phenyl) urea The urea was synthesized by the treatment of 2-phenoxyphenyl carboxylic acid(2 mmol.) with diphenyl phosphoryl azide(0.475 mL) and triethyl amine(.14 mL) in DMF at 80 °C after 24 hours the 2-amino 5-nitro phenol (1 equiv.) was added. The reaction was heated for 24 hours at 80°C. The reaction product was oiled out with hexane. The residue was dissolved in methanol and the solid was precipitated out with water.(180 mg, 24%) EI-MS m/z 364(M-H)

30

35

#### Example 48

##### Synthesis of N-(2-hydroxy-4-fluoro phenyl) N'-(2-bromo phenyl) urea

a)Synthesis of 2-hydroxy 4-fluoro aniline



- 47 -

3-fluoro 6-nitro phenol (2 g, 11 mmol) was treated with 10%Pd/C(1 g) at 23 °C. The reaction mixture was flushed with hydrogen gas and the reaction was allowed to stir 12 h before it was filtered through celite. The filtrate was concentrated *in vacuo* to afford the title compound (1.4 g, 77%). EI-MS m/z 169(M+H)<sup>+</sup>

5. b)Synthesis of N-(2-hydroxy-4-fluoro phenyl) N'-(2-bromo phenyl) urea

The urea was prepared from 2-hydroxy 4-fluoro aniline(254 mg, 2 mmol) and 2-bromo phenyl isocyanate by general Method B. It was purified by dilution with methylene chloride and precipitation with hexane(173 mg, 26%). EI-MS m/z 325 (M+H)<sup>+</sup>

10

Example 49

Synthesis of N-(2-hydroxy 3,4-difluoro phenyl) N'-(2-bromo phenyl) urea

a)Synthesis of 2-hydroxy 3,4-difluoro aniline

2,3 difluoro 6-nitro phenol (2 g, 11 mmol) was treated with 10%Pd/C(1 g) at 23 °C. The reaction mixture was flushed with hydrogen gas and the reaction was allowed to stir 12 h before it was filtered through celite. The filtrate was concentrated *in vacuo* to afforded the title compound (1.6 g, 97%). EI-MS m/z 146(M+H)<sup>+</sup>

15

b)Synthesis of N-(2-hydroxy 3,4-difluoro phenyl) N'-(2-bromo phenyl) urea

The urea was prepared from 2-hydroxy 3,4-difluoro aniline(0.290 g, 2 mmol) and 2-bromo phenyl isocyanate(0.4 g) by general Method B. It was purified by dilution with methylene chloride and precipitation with hexane(0.254 g, 37%). EI-MS m/z 343(M+H)<sup>+</sup>

20

Example 50

Synthesis of N-(2-hydroxy 3-naphthyl) N'-(2-bromo phenyl) urea

The urea was prepared from 3-amino 2-hydroxy naphthalene(0.320 g, 2 mmol) and 2-bromo phenyl isocyanate(.40 g) by general Method B. It was purified by dilution of the with methylene chloride and precipitation with hexane(0.339, 47%).EI-MS m/z 357(M+H)<sup>+</sup>

25

Example 51

Synthesis of N-(2-hydroxy 4-phenyl phenyl) N'-(2-bromo phenyl) urea

a)Synthesis of 2-nitro 5-phenyl phenol

A solution of 3-phenyl phenol(2 g, 11 mmol) in acetic acid was treated with concentrated nitric acid drop-wise until all starting material was consumed. The solution was partitioned between water and methylene chloride. The organic phase was separated and the aqueous phase was extracted once more with methylene chloride. The combined organic phases were dried over sodium sulfate, filtered and concentrated *in vacuo*. The residue was purified by silica gel chromatography(ethyl acetate/hexanes) to afford desired (1.2 g, 50%).<sup>1</sup>H

30

35

- 48 -

NMR (CDCl<sub>3</sub>):  $\delta$  10.65(s, 1H), 8.18 (d, 1H, J = 10.0 Hz), 7.65 (d, 2H, J = 6.0 Hz), 7.49 (m, 3H), 7.34 (s, 1H), 7.10 (d, 1H, J=10.0Hz).

b) Synthesis of 2-amino 5-phenyl phenol

A solution of 2-nitro 5-phenyl phenol(1.2 g, 5.5 mmol) in methanol was treated with 10% Pd/C(1.2g). The reaction mixture was flushed with hydrogen and allowed to stir overnight. The reaction mixture was filtered through celite and the filtrate was concentrated *in vacuo* to afford desired (1.01 g, 98%). EI-MS m/z 186(M+H)<sup>+</sup>

c) Synthesis of N-(2-hydroxy 4-phenyl phenyl) N'-(2-bromo phenyl) urea

The urea was prepared from 2-hydroxy 4-phenyl aniline(0.185 g, 1 mmol) and 2-bromo phenyl isocyanate(0.198 g) by general Method B. It was purified by dilution of the DMF solution with methylene chloride and precipitation with hexane(215 mg, 56%). EI-MS m/z 383(M+H)<sup>+</sup>

Example 52

15 Synthesis of N-(2-hydroxy 4-methyl phenyl) N'-(2-bromo phenyl) urea

The urea was prepared from 2-hydroxy 4-methyl aniline(.274g, 2 mmol) and 2-bromo phenyl isocyanate(0.40 g, 2 mmol) by general Method B. It was purified by dilution of the DMF solution with methylene chloride and precipitation with hexane(249 mg, 39%). EI-MS m/z 319(M-H)<sup>-</sup>

20

Example 53

Synthesis of N(2-hydroxy 4-nitro phenyl) N'-(2-phenylamino phenyl) urea

The urea was synthesized by the treatment of 2-tertbutyldimethylsilyloxy 4-nitro phenyl isocyanate(example 9a, 0.419g, 1.5 equiv.) with 2-anilino aniline(0.184 g, 1 equiv.) in THF overnight at 40 °C. The desired product precipitated out of the reaction mixture(30 mg, 8%) EI-MS m/z 365(M+H)<sup>+</sup>

25

Example 54

Synthesis of N-(2-hydroxy 3-carboxylate phenyl) N'-(2-bromo phenyl) urea

30 The urea was prepared from 2-hydroxy 3-amino benzoic acid(300 mg, 2 mmol) and 2-bromo phenyl isocyanate by general Method B. It was purified by dilution of the DMF solution with methylene chloride and precipitation with hexane(.287 g, 41%). EI-MS m/z 351(M+H)<sup>+</sup>

35

Example 55

Synthesis of N(2-sulthydryl 4-bromo phenyl) N'-(2-bromo phenyl) urea

a) Synthesis of 2-amino 6-bromo thiazole

4-Bromo aniline(4.3 g, 25 mmol, 1 equiv.) and ammonium thiocyanate(5.7 g, 3equiv.) was dissolved in acetic acid and treated with bromine(4 g, 1equiv.) at room temperature. After complete disappearance of starting material the reaction mixture was poured into water and the solid was collected. The solid was used in the next step without any purification(3.6 g, 46%).

5 EI-MS m/z 229(M+H)<sup>+</sup>

b)Synthesis of bis (3-bromo 6-amino phenyl) disulfide

10 The 2-amino 6-bromo thiazole hydrobromide (500 mg, 1.6 mmol) in water(5mL) was treated with KOH (2.5 g) was heated at reflux for 8 h at reflux. The reaction mixture was then acidified to pH 4 with acetic acid and extracted with methylene chloride. The methylene chloride mixture was concentrated *in vacuo*. The residue was dissolved in DMSO and treated with I<sub>2</sub>. After stirring overnight at room temperature the reaction mixture was partitioned between methylene chloride and saturated sodium bicarbonate. The methylene chloride layer was dried with magnesium sulfate and concentrated *in vacuo*. The resulting solid was purified by flash chromatography(ethyl acetate/hexane) to afford the title compound (230 mg, 34%).

15 EI-MS m/z 405(M+H)<sup>+</sup>

c)Synthesis of N(2-sulphydryl 4-bromo phenyl) N'-(2-bromo phenyl) urea

20 A solution of (3-bromo 6-amino phenyl) disulfide(201 mg, .5 mmol) in DMF was treated with 2-bromo phenyl isocyanate(1 mmol) at 80 °C overnight. The reaction mixture was diluted with methylene chloride and a solid was precipitated out with hexanes. The solution was dissolved in MeOH and treated with NaBH<sub>4</sub>. After gas evolution ceased the reaction mixture was carefully acidified with 1N HCl and the resulting solid was filtered(52 mg, 13%). EI-MS m/z 399 (M-H)<sup>-</sup>

#### Example 56

25 Synthesis of N-(2-hydroxy 4-nitro phenyl) N'-(2-iodo phenyl) urea

30 The urea was synthesized by the treatment of 2-iodo benzoic acid(5 g, 20 mmol) with diphenyl phosphoryl azide(1 equiv.) and triethyl amine (1 equiv.) in DMF at 80 °C after gas evolution ceased the 5-nitro 2-amino phenol (3 g, 1 equiv.) was added. The reaction was heated overnight at 80°C. The reaction mixture was purified by filtering through a plug of silica with methylene chloride. The desired product was then precipitated out with hexane. Filtering afforded the desired compound(1.08 g, 13%). EI-MS m/z 398(M-H)<sup>-</sup>

#### Example 57

Synthesis of N-(2-hydroxy 4-nitro phenyl) N'-(2-bromo phenyl) thiourea

35 The thiourea was synthesized by treatment of the 2-*tert*-butyldimethylsilyloxy 4-nitro phenyl thioisocyanate(see example 9a, 3.73 mmol) with 2-bromo aniline in toluene at 88°C over 36 h. The solution was concentrated and the residue was purified by flash

- 50 -

- chromatography(EtOAc/Hexanes). The fraction slightly lower *rf* than starting material contained the desired compound. This fraction was concentrated and then treated with triethyl aminic hydrofluoride in acetonitrile for 15 minutes at 23 °C. The reaction mixture was then concentrated *in vacuo* and the residue was purified by flash chromatography(ethyl acetate/hexanes) to give N-(2-hydroxy 4-nitro phenyl) N'-(2-bromo phenyl) thiourea(52 mg. 4%). EI-MS *m/z* 369(M+H)<sup>+</sup>

### Example 58

#### Synthesis of N-(2-phenylsulfamido) 4-cyanophenyl N'-(2-bromo phenyl) urea

- 10 a)Synthesis of 3-(phenylsulfamido) benzonitrile

The of 3-(phenylsulfamido) benzonitrile was synthesized from the 3-cyano aniline (23.9 g, .2 mol) by Method C. It was purified by recrystallization from EtOH(15.8 g, 31%). <sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 7.95(s, 1H), 7.84 (d, 2H, J = 8.0 Hz), 7.59 (t, 1H, J = 8.0 Hz), 7.45 (m, 2H), 7.35 (m, 4H).

- 15 b)Synthesis of 3-(phenylsulfamido) 4-nitro benzonitrile

The 3-(phenylsulfamido) benzonitrile(10 g, 39 mmol) was dissolved in acetic anhydride and treated with concentrated nitric acid dropwise at room temperature until all the starting material had been consumed. The reaction mixture was then quenched by carefully pouring it into sodium bicarbonate and left to sit until all gas evolution had subsided. It was then partitioned between methylene chloride and water. The organic layer was dried over sodium sulfate and filtered. The reaction mixture was concentrated *in vacuo*, absorbed onto silica gel and purified by column chromatography(methylene chloride/hexane) to afford the title compound (1.7g, 15%). EI-MS *m/z* 302(M+H)<sup>+</sup>

- 20 c)Synthesis of 3-(phenylsulfamido) 4-amino benzonitrile

25 The 3-(phenylsulfamido) 4-nitro benzonitrile(1.5 g, 4.9 mmol) was treated with tin chloride dihydrate in EtOH at 80 °C for 12h. It was then concentrated and flushed through a plug of silica gel with 5% methanol/methylene chloride. The filtrate was absorbed onto silica gel and purified by flash chromatography(ethyl acetate/hexane) to afford the title compound (0.9 g, 60%). EI-MS *m/z* 274 (M+H)<sup>+</sup>

- 30 d)Synthesis of N-(2-phenylsulfamido) 4-cyanophenyl N'-(2-bromo phenyl) urea

The urea was synthesized from 2-(phenylsulfamido) 4-amino benzonitrile(77 mg, 0.28 mmol) and 2-bromo phenyl isocyanate by general Method C. It was purified by column chromatography(ethyl acetate/hexane) to afford the title compound (30 mg, 22%). EI-MS *m/z* 469(M+H)<sup>+</sup>

35

### Example 59

#### Synthesis of N-(2-(phenyl sulfamido) phenyl) N'-(2-bromo phenyl) urea

- 51 -

## a) Synthesis of 2-(phenyl sulfamido) aniline

The sulfonamide was synthesized from phenyl sulfonyl chloride (0.01 mmol) and o-phenylene diamine (1.08 g, 0.01 mmol) by general Method C. It was purified by recrystallization from EtOH (1.0 g, 40%). EI-MS m/z 249(M+H)<sup>+</sup>

## 5 b) Synthesis of N-(2-(phenyl sulfamido) phenyl) N'-(2-bromo phenyl) urea

The urea was synthesized from 2-(phenyl sulfamido) aniline (1 mmol) and 2-bromo phenyl isocyanate by general Method B. It was purified by dilution with methylene chloride and precipitation with hexane. Filtering afforded the desired compound (0.234 g, 52%). EI-MS m/z 446(M+H)<sup>+</sup>

10

Example 60Synthesis of N-(2-(styryl sulfamido) phenyl) N'-(2-bromo phenyl) urea

## a) Synthesis of 2-(styryl sulfamido) aniline

15 The sulfonamide was synthesized from styryl sulfonyl chloride (0.01 mol) and o-phenylene diamine (0.01 mol) by general Method C. It was purified by recrystallization from EtOH (1.2 g, 60%) EI-MS m/z 199(M+H)<sup>+</sup>

## b) Synthesis of N-(2-(styryl sulfamido) phenyl) N'-(2-bromo phenyl) urea

20 The urea was synthesized from 2-(styryl sulfamido) aniline (1 mmol) and 2-bromo phenyl isocyanate (1 mmol) by general Method B. It was purified by dilution with methylene chloride and precipitation with hexane. Filtering afforded the desired compound (0.309 g, 65%). EI-MS m/z 472(M+H)<sup>+</sup>

Example 61Synthesis of 2-[(3,4-dimethoxyphenyl)sulfonyl amino] phenyl) N'-(2-bromo phenyl) urea

## 25 a) Synthesis of 2-[(3,4-dimethoxyphenyl)sulfonyl amino] phenyl aniline

The sulfonamide was synthesized from 3,4-dimethoxy phenyl sulfonyl chloride (0.01 mol) and o-phenylene diamine by general Method C. It was purified by recrystallization from EtOH (0.65 g, 21%). EI-MS m/z 309(M+H)<sup>+</sup>

## b) Synthesis of 2-[(3,4-dimethoxyphenyl)sulfonylamino] phenyl) N'-(2-bromo phenyl) urea

30 The urea was synthesized from 2-[(3,4-dimethoxyphenyl)sulfonyl amino] phenyl aniline (1 mmol) and 2-bromo phenyl isocyanate by general Method B. It was purified by dilution with methylene chloride and precipitation with hexane. Filtering afforded the desired compound (0.062 g, 12%). EI-MS m/z 504(M+H)<sup>+</sup>

35

Example 62Synthesis of N-(2-[(4-acetamidophenyl)sulfonylamino] phenyl) N'-(2-bromo phenyl) urea

## a) Synthesis of 2-[(4-acetamidophenyl)sulfonylamino] phenyl aniline

The sulfonamide was synthesized from 4-acetamidophenyl sulfonyl chloride(0.01 mol) and o-phenylene diamine(0.01 mol) by general Method C. It was purified by recrystallization from EtOH(1.27 g, 40%) EI-MS m/z 304(M-H)<sup>+</sup>.

b)Synthesis of N-(2-[(4-acetamidophenylsulfonyl)amino] phenyl) N'-(2-bromo phenyl) urea

- 5        The urea was synthesized from 2-[(4-acetamidophenyl)sulfonylamino]phenyl aniline(1 mmol) and 2-bromo phenyl isocyanate(1 mmol) by general Method B. It was purified by dilution with methylene chloride and precipitation with hexane. Filtering afforded the desired compound(0.12 g, 24%). EI-MS m/z 501(M-H)<sup>+</sup>

10

#### Example 63

##### Synthesis of N-(2-(2-thiophene sulfamido phenyl) N'-(2-bromo phenyl) urea

a)Synthesis of 2-(2-thiophene sulfamido) aniline

- 15        The sulfonamide was synthesized from 2-thiophene sulfonyl chloride(0.01 mol) and o-phenylene diamine(0.01 mol) by general Method C. It was purified by recrystallization from EtOH(0.77 g, 30%). EI-MS m/z 255 (M+H)<sup>+</sup>

b)Synthesis of N-(2-(2-thiophene sulfonyl amino phenyl) N'-(2-bromo phenyl) urea

- 20        The urea was synthesized from 2-(2-thiophene sulfonyl amino) aniline(1 mmol) and 2-bromo phenyl isocyanate(1 mmol) by general Method B. It was purified by dilution with methylene chloride and precipitation with hexane. Filtering afforded the desired compound(0.29 g, 64%). EI-MS m/z 450(M-H)<sup>+</sup>

#### Example 64

##### Synthesis of N-(2-(3-tolyl sulfonyl amino phenyl) N'-(2-bromo phenyl) urea

- 25        a)Synthesis of 2-(3-tolyl sulfonyl amino) aniline

The sulfonamide was synthesized from 3-tolyl sulfonyl chloride(0.01 mol) and o-phenylene diamine(0.01 mol) by general Method C. It was purified by recrystallization from EtOH(0.73g, 28%).EI-MS m/z 263 (M+H)<sup>+</sup>

b)Synthesis of N-(2-((3-tolyl sulfonyl amino) phenyl) N'-(2-bromo phenyl) urea

- 30        The urea was synthesized from 2-(3-tolyl sulfonyl amino) aniline(1 mmol) and 2-bromo phenyl isocyanate(1 mmol) by general Method B. It was purified by dilution with methylene chloride and precipitation with hexanes. It was recrystallized two times with EtOH(25 mg, 5%). EI-MS m/z 458(M-H)<sup>+</sup>

35

#### Example 65

##### Synthesis of N-(2-(8-quinoliny sulfonyl amino) phenyl) N'-(2-bromo phenyl) urea

a)Synthesis of 2-(8-quinoliny sulfonyl amino) aniline

The sulfonamide was synthesized from 8-quinolinyI sulfonyl chloride(0.01 mol) and o-phenylene diamine(0.01 mol) by general Method C. It was purified by recrystallization from EtOH(0.82 g, 27%).EI-MS m/z 300 (M+H)<sup>+</sup>

b)Synthesis of N-(2-( 8-quinolinyI) sulfonyl amino) phenyl) N'-(2-bromo phenyl) urea

- 5 The urea was synthesized from 2-((8-quinolinyI) sulfonyl amino) aniline(1 mmol) and 2-bromo phenyl isocyanate(1 mmol) by general Method B. It was purified by dilution with methylene chloride and precipitation with hexane. Filtering afforded the desired compound(0.23 g, 46% ).EI-MS m/z 495(M-H)<sup>-</sup>

10

#### Example 66

Synthesis of N-(2-( benzyl sulfonyl amino) phenyl) N'-(2-bromo phenyl) urea

a)Synthesis of 2-(benzyl sulfonyl amino) aniline

- 15 The sulfonamide was synthesized from benzyl sulfonyl chloride(0.01 mol) and o-phenylene diamine(0.01 mol) by general Method C. It was purified by recrystallization from EtOH(0.87g, 33%). EI-MS m/z 263(M+H)<sup>+</sup>.

b)Synthesis of N-(2-( benzyl sulfonyl amino) phenyl) N'-(2-bromo phenyl) urea

- 20 The urea was synthesized from 2-( benzyl sulfonyl amino) aniline(1 mmol) and 2-bromo phenyl isocyanate(1mmol) by general Method B. It was purified by dilution with methylene chloride and precipitation with hexane. Filtering afforded the desired compound(0.11 g, 23% ). EI-MS m/z 460 (M+H)<sup>+</sup>

#### Example 67

Synthesis of N-(2-hydroxy-4-azidophenyl)-N'-(2-methoxyphenyl)urea

a)Synthesis of N-(2-hydroxy-4-aminophenyl)-N'-(2-methoxyphenyl)urea

- 25 To a solution of N-(2-hydroxy-4-nitro phenyl)-N'-(2-methoxyphenyl)urea(1.0 g, example 15) in methanol, palladium (on activated carbon, 10% ) (100 mg) was added. Then the reaction mixture was hydrogenated under a hydrogen balloon for 18 hours. The solid was filtered off by celite and washed three times by methanol. The filtrate was concentrated under reduced pressure to give amine compound (0.8 g, 89%). EI-MS m/z 274 (M+H)<sup>+</sup>

- 30 b)Synthesis of N-(2-hydroxy-4-azidophenyl)-N'-(2-methoxyphenyl)urea

- The N-(2-hydroxy-4-aminophenyl)-N'-(2-methoxyphenyl)urea (300 mg, 1.17 mmol) was added to HCl/H<sub>2</sub>O (1.17 mL/2.34 mL), cooled to 0°C. Sodium nitrite (80.7 mg, 1.17 mmol) was added to the reaction mixture. The reaction mixture was stirred at 0°C for 30 minutes. The sodium azide (76 mg, 1.17 mmol) was added to reaction mixture and it was  
35 warmed to room temperature. The reaction mixture was stirred at room temperature for 18 hours. Then it was extracted with three times by ethyl acetate. The organic extracts were combined, dried over MgSO<sub>4</sub>, filtered and concentrated under reduced pressure and

chromatography of the resulting solid on silica gel (hexane : ethyl acetate: 5:1) gave product (125 mg, 38%). EI-MS m/z 300 (M+H)<sup>+</sup>

### Example 68

#### 5 Preparation of N-[2-hydroxy-5-cyanophenyl]-N'-[2-bromophenyl] urea

##### a) Preparation of 2-amino-4-cyanophenol

To a solution of 2-nitro-4-cyanophenol (10g, 61 mmol) in methanol (250 mL) was added 10% Pd/C (1g). The mixture was flushed with argon, then hydrogen was bubbled through the solution for 10 min. and a hydrogen atmosphere was maintained at balloon pressure overnight.

- 10 The mixture was filtered through celite and the celite was washed with methanol. The solvent was evaporated and chromatography of the resulting solid on silica gel (5% MeOH/ CH<sub>2</sub>Cl<sub>2</sub>) gave the desired product (8.0 g, 97%). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 6.96 (d, 1H), 6.90 (dd, 1H), 6.77 (d, 1H).

##### b) Preparation of N-[2-hydroxy-5-cyanophenyl]-N'-[2-bromophenyl] urea

- 15 N-[2-hydroxy-5-cyanophenyl]-N'-[2-bromophenyl] urea was prepared from 2-amino-4-cyanophenol (268 mg, 2.00 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane (1/20) and filtering. (540 mg, 81%). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 8.10 (d, 1H), 7.87 (d, 1H), 7.43 (d, 1H), 7.20 (t, 1H), 7.09 (d, 1H), 6.86 (t, 1H), 6.77 (d, 1H).

20

### Example 69

#### Preparation of N-[2-hydroxy-3-fluorophenyl]-N'-[2-bromophenyl] urea

##### a) Preparation of 2-amino-3-fluorophenol

To a solution of 2-nitro-3-fluorophenol (1g, 6.4 mmol) in methanol (250 mL) was added 10% Pd/C (1g). The mixture was flushed with argon, then hydrogen was bubbled through the solution for 10 min. and a hydrogen atmosphere was maintained at balloon pressure overnight. The mixture was filtered through celite and the celite was washed with methanol. The solvent was evaporated and chromatography of the resulting solid on silica gel (5% MeOH/ CH<sub>2</sub>Cl<sub>2</sub>) gave the desired product (650 mg, 80.2%). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 6.41-6.17 (m, 3H).

- 30 b) Preparation of N-[2-hydroxy-3-fluorophenyl]-N'-[2-bromophenyl] urea.

N-[2-Hydroxy-3-fluorophenyl]-N'-[2-bromo phenyl] urea was prepared from 2-amino-3-fluorophenol (254 mg, 2.00 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane (1/20) and filtering. (500 mg, 77%). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 8.05 (d, 1H), 7.50 (d, 1H), 7.26 (t, 1H), 7.18 (d,

- 35 1H), 6.92 (t, 1H), 6.86-6.68 (m, 2H).

### Example 70

#### Preparation of N-2-[1-hydroxyfluorene]-N'-[2-bromophenyl] urea



## a) Preparation of 2-amino-1-hydroxyfluorene

To a solution of 1-hydroxy-2-nitrofluorene (250 mg, 1.23 mmol) in methanol (250 mL) was added 10% Pd/C (1 g). The mixture was flushed with argon, then hydrogen was bubbled through the solution for 10 min. and a hydrogen atmosphere was maintained at balloon pressure overnight. The mixture was filtered through celite and the celite was washed with methanol. The solvent was evaporated and chromatography of the resulting solid on silica gel (5% MeOH/ CH<sub>2</sub>Cl<sub>2</sub>) gave the desired product (171 mg, 81.2 %). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 7.60 (d, 1H), 7.47 (d, 1H), 7.28 (t, 1H), 7.18 (m, 2H), 6.82 (d, 1H), 3.76 (s, 2H).

## b) Preparation of N-2-[1-hydroxyfluorene]-N'-[2-bromophenyl] urea

N-2-[1-hydroxyfluorene]-N'-[2-bromo phenyl] urea was prepared from 2-amino-1-hydroxyfluorene (170 mg, 0.86 mmol) according to the procedure in General Method B. The product was purified by chromatography of the resulting solid on silica gel (30% EtOAc/ Hexane) to give the desired product (300 mg, 84.5 %). <sup>1</sup>H NMR (CD<sub>3</sub>Cl): δ 8.04 (d, 1H), 7.66 (d, 1H), 7.49 (t, 2H), 7.35-7.20 (m, 4H), 7.09 (d, 1H), 6.90 (t, 1H).

Example 71Preparation of N-3-[2-hydroxy-9,10-anthraquinonyl]-N'-[2-bromophenyl] urea

N-3-[2-Hydroxy-9,10-anthraquinonyl]-N'-[2-bromophenyl] urea was prepared from 2-hydroxy-3-aminoanthraquinone (480 mg, 2.0 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane (1/20) and filtering. (610 mg, 70 %). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 8.93 (s, 1H), 8.12 (m, 2H), 8.02 (d, 1H), 7.77 (m, 2H), 7.61 (d, 1H), 7.52 (s, 1H), 7.38 (t, 1H), 7.05 (t, 1H).

Example 72Preparation of N-[2-hydroxy-3-fluoro-5-bromophenyl]-N'-[2-bromophenyl] urea

## a) Preparation of 2-amino-6-fluoro-4-bromophenol

A mixture of 4-bromo-2-fluoro 6-nitrophenol (1 g, 4.2 mmol) and tin (II) chloride (4.78 g, 21.2 mmol) in ethanol (50 mL) was heated at 80°C under argon. After 2 hours, the starting material had disappeared and the solution was allowed to cool down and then poured into ice. The pH was made slightly basic (pH 7-8), by addition of solid NaOH, before being extracted with ethyl acetate. The organic phase was washed with brine, dried over MgSO<sub>4</sub> and filtered. The solvent was evaporated and chromatography of the resulting solid on silica gel (4% MeOH/ CH<sub>2</sub>Cl<sub>2</sub>) gave the desired product (710 mg, 82 %). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 6.51-6.40 (m, 2H).

## b) Preparation of N-[2-hydroxy-3-fluoro-5-bromophenyl]-N'-[2-bromophenyl] urea

N-[2-hydroxy-3-fluoro-5-bromophenyl]-N'-[2-bromophenyl] urea was prepared from 2-amino-6-fluoro-4-bromophenol (254 mg, 2.0 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane (1/20)

- 56 -

and filtering. (500 mg, 77%).  $^1\text{H}$  NMR ( $\text{CD}_3\text{OD}$ ):  $\delta$  7.98 (s, 1H), 7.91 (d, 1H), 7.60 (d, 1H), 7.33 (t, 1H), 7.00 (t, 1H), 6.94 (d, 1H).

### Example 73

#### 5 Preparation of N-[2-hydroxy-3-chlorophenyl]-N'-[2-bromophenyl] urea

##### a) Preparation of 2-amino-3-chlorophenol

A mixture of 3-chloro-2-nitrophenol (250 mg, 1.4 mmol) and tin (II) chloride (1.2 g, 5.3 mmol) in ethanol (50 mL) was heated at 80°C under argon. After 2 hours, the starting material has disappeared and the solution was allowed to cool down and then poured into ice.

- 10 The pH was made slightly basic (pH 7-8), by addition of solid NaOH, before being extracted with ethyl acetate. The organic phase was washed with brine, dried over  $\text{MgSO}_4$  and filtered. The solvent was evaporated and chromatography of the resulting solid on silica gel (4% MeOH/ $\text{CH}_2\text{Cl}_2$ ) gave the desired product (143 mg, 69%).  $^1\text{H}$  NMR ( $\text{CD}_3\text{OD}$ ):  $\delta$  6.75 (t, 1H), 6.70 (d, 1H), 6.65 (d, 1H).

##### 15 b) Preparation of N-[2-hydroxy-3-chlorophenyl]-N'-[2-bromophenyl] urea

N-[2-hydroxy-3-chlorophenyl]-N'-[2-bromophenyl] urea was prepared from 2-amino-3-chlorophenol (143 mg, 1.00 mmol) according to the procedure in General Method B. The product was purified by chromatography of the resulting solid on silica gel (30% EtOAc/Hexane) to give the desired product (195 mg, 57%).  $^1\text{H}$  NMR ( $\text{CD}_3\text{OD}$ ):  $\delta$  7.81 (d, 1H), 7.68 (d, 1H), 7.47 (d, 1H), 7.20 (t, 1H), 6.90 (m, 2H), 6.70 (t, 1H).

### Example 74

#### Preparation of N-[2-hydroxy-3-trifluoromethylphenyl]-N'-[2-bromophenyl] urea

##### a) Preparation of 2-nitro-6-trifluoromethylphenol

- 25 2-trifluoromethylphenol (3.00 g, 18.5 mmol) was dissolved in methylene chloride (40 mL) followed by the addition of sodium nitrate (1.73 g, 20.4 mmol). The addition of sulfuric acid (23 mL/ 3M) was then made, followed by addition of a catalytic amount of sodium nitrite. The mixture was allowed to stir. After 24 hours, the reaction mixture was diluted with methylene chloride and extracted with water. The organic layer was dried over
- 30  $\text{MgSO}_4$  and filtered. The solvent was evaporated and chromatography of the resulting solid on silica gel (4% MeOH/ $\text{CH}_2\text{Cl}_2$ ) gave the desired product (1.84 g, 47%).  $^1\text{H}$  NMR ( $\text{CD}_3\text{COCD}_3$ ):  $\delta$  8.35 (d, 1H), 7.95 (d, 1H), 7.13 (t, 1H).

##### b) Preparation of 2-amino-6-trifluoromethylphenol

- 35 A mixture of 6-trifluoromethyl-2-nitrophenol (1.84 g, 8.67 mmol) and tin (II) chloride (6.0 g, 26.2 mmol) in ethanol (150 mL) was heated at 80°C under argon. After 2 hours, the starting material has disappeared and the solution was allowed to cool down and then poured into ice. The pH was made slightly basic (pH 7-8), by addition of solid NaOH, before being

extracted with ethyl acetate. The organic phase was washed with brine, dried over  $\text{MgSO}_4$  and filtered. The solvent was evaporated and chromatography of the resulting solid on silica gel (4% MeOH/  $\text{CH}_2\text{Cl}_2$ ) gave the desired product (1.35 g, 88 %).  $^1\text{H}$  NMR ( $\text{CD}_3\text{OD}$ ):  $\delta$  6.93 (d, 1H), 6.82 (t, 1H), 6.78 (d, 1H).

5 c) Preparation of N-[2-hydroxy-3-trifluoromethylphenyl]-N'-[2-bromophenyl] urea

N-[2-hydroxy-3-trifluoromethylphenyl]-N'-[2-bromophenyl] urea was prepared from 2-amino-6-trifluoromethylphenol (280mg, 1.60 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane(1/20) and filtering. (390mg, 65%).  $^1\text{H}$  NMR ( $\text{CD}_3\text{OD}$ ):  $\delta$  7.99 (d, 1H), 7.60 (d, 1H), 7.58 (d, 1H), 7.34 (t, 1H), 7.30 (d, 1H), 7.00 (t, 1H), 6.96 (d, 1H).

Example 75

Preparation of N-[3,4 diphenyl-2-hydroxyphenyl]-N'-[2-bromophenyl] urea

15 N-[3,4 diphenyl-2-hydroxyphenyl]-N'-[2-bromophenyl] urea was prepared from 2-amino-5,6 diphenylphenol (50mg, 0.19 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane(1/20) and filtering (61mg, 69%).  $^1\text{H}$  NMR ( $\text{CD}_3\text{OD}$ ):  $\delta$  7.97 (d, 1H), 7.66 (d, 1H), 7.58 (d, 1H), 7.31 (t, 1H), 7.25-7.00 (m, 11H), 6.91 (d, 1H).

20 Example 76

Preparation of N-[2-hydroxy-3-glycinemethylestercarbonylphenyl]-N'-[2-bromophenyl] urea

25 N-[2-hydroxy-3-glycinemethylestercarbonylphenyl]-N'-[2-bromophenyl] urea was prepared from 6-glycinemethylestercarbonyl-2-aminophenol (50mg, 0.22 mmol), purchased from the University of New Hampshire, according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane(1/20) and filtering (65mg, 69%).  $^1\text{H}$  NMR ( $\text{CD}_3\text{OD}$ ):  $\delta$  8.14 (d, 1H), 7.96 (d, 1H), 7.49 (d, 1H), 7.24 (t, 2H), 6.89 (dd, 1H), 6.81 (t, 1H), 4.10 (s, 2H), 3.74 (s, 3H).

Example 77

30 Preparation of N-[2-hydroxy-3-glycinecarbonylphenyl]-N'-[2-bromophenyl] urea

N-[2-Hydroxy-3-glycinecarbonylphenyl]-N'-[2-bromophenyl] urea was prepared from N-[2-hydroxy-3-glycinemethylestercarbonylphenyl]-N'-[2-bromophenyl] urea(50mg, 0.12 mmol) by stirring in a 3/1 ratio of methanol/water (10 mL). Addition of 1 equiv. of lithium hydroxide was added and stirring continued until the starting material had disappeared. (45mg, 92%). The product was purified by chromatography of the resulting solid on silica gel (9/1/0.1  $\text{CH}_2\text{Cl}_2$ / MeOH/ AcOH) to give the desired product(195mg, 57%).  $^1\text{H}$  NMR ( $\text{CD}_3\text{OD}$ ):  $\delta$  8.14 (d, 1H), 7.92 (d, 1H), 7.60 (d, 1H), 7.46 (d, 1H), 7.34 (t, 1H), 7.04 (t, 1H), 6.82 (t, 1H), 3.96 (2H).

### Example 78

### Preparation of N-[2-hydroxy-3,5-dichlorophenyl]-N'-[2-bromophenyl] urea

### a) Preparation of 2-amino-4,6-dichlorophenol

5 A mixture of 4,6-dichloro-2-nitrophenol (1 g, 4.8mmol) and tin (II) chloride (3.2 g, 14.4mmol) in ethanol (50mL) was heated at 80°C under argon. After 2 hours, the starting material had disappeared and the solution was allowed to cool down and then poured into ice. The pH was made slightly basic (pH 7-8), by addition of solid NaOH, before being extracted with ethyl acetate. The organic phase was washed with brine, dried over  $\text{MgSO}_4$  and filtered.

10 The solvent was evaporated and chromatography of the resulting solid on silica gel (4% MeOH/ $\text{CH}_2\text{Cl}_2$ ) gave the desired product (685 mg, 80 %).  $^1\text{H}$  NMR ( $\text{CD}_3\text{OD}$ ):  $\delta$  6.75 (s, 1H), 6.61 (s, 1H).

#### b) Preparation of N-[2-hydroxy-3,5-dichlorophenyl]-N'-[2-bromophenyl] urea

N-[2-Hydroxy-3,5-dichlorophenyl]-N'-[2-bromophenyl] urea was prepared from 2-amino-4,6-dichlorophenol (143mg, 1.00 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane(1/20) and filtering. (660mg, 88%). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 7.96 (s, 1H), 7.89 (d, 1H), 7.60 (d, 1H), 7.35 (t, 1H), 7.00 (t, 1H), 6.95 (dd, 1H).

**20** **Example 79**

#### Preparation of N-[2-hydroxy-3-nitrophenyl]-N'-[2-bromophenyl] urea

N-[2-Hydroxy-3-nitrophenyl]-N'-[2-bromophenyl] urea was prepared from 2-hydroxy-3-nitroaniline (1.25g, 8.1 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane(1/20) and filtering. (2.4g, 84%). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 8.45 (d, 1H), 7.94 (d, 1H), 7.78 (d, 1H), 7.60 (d, 1H), 7.35 (t, 1H), 7.01 (m, 2H).

### Example 80

### Preparation of N-[2-hydroxy-4-naphthalenesulfonic acid]-N'-[2-bromophenyl] urea

30 N-[2-hydroxy-4-naphthalenesulfonic acid]-N'-[2-bromophenyl] urea was prepared from 1-amino-2-hydroxy-4-naphthalenesulfonic acid (0.48g, 2.0 mmol) according to the procedure in General Method B and the addition of 1mL of triethylamine. The product was purified by precipitation from methylene chloride/ hexane (1/20) and filtering. (690 mg, 79%).  
 35 <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 8.14 (s, 1H), 8.04 (d, 1H), 7.98 (m, 2H), 7.61-7.55 (m, 3H), 7.43 (t, 1H), 6.98 (t, 1H).

### Example 8.1

#### Preparation of N-[2-hydroxy-5-naphthalenesulfonic acid]-N'-[2-bromophenyl] urea

N-3-[2-hydroxy-5-naphthalensulfonic acid]-N'-[2-bromophenyl] urea was prepared from 2-amino-3-hydroxy-6-naphthalensulfonic acid (0.48g, 2.0 mmol) according to the procedure in General Method B and the addition of 1mL of triethylamine. The product was purified by precipitation from methylene chloride/ hexane(1/20) and filtering. (715 mg, 82%).

5 <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 8.09 (s, 1H), 7.96 (d, 1H), 7.65-7.48 (m, 3H), 7.36 (t, 1H), 7.25 (s, 1H), 7.04 (m, 2H).

### Example 82

#### Preparation of N-[2-hydroxy-3,4-dichlorophenyl]-N'-[2-bromophenyl] urea

10 a)Preparation of 2-nitro-5,6 dichlorophenol

2,3-dichlorophenol (3.26g, 20mmol) was dissolved in methylene chloride(40mL) followed by the addition of sodium nitrate (1.88g, 22mmol). The addition of sulfuric acid (20mL/ 3M) was then made, followed by addition of a catalytic amount of sodium nitrite. The mixture was allowed to stir. After 24 hours, the reaction mixture was diluted with methylene chloride and extracted with water. The organic layer was dried over MgSO<sub>4</sub> and filtered. The solvent was evaporated and chromatography of the resulting solid on silica gel (4%MeOH/ CH<sub>2</sub>Cl<sub>2</sub>) gave the desired product(1.8 g, 44 %). <sup>1</sup>H NMR (CD<sub>3</sub>COCD<sub>3</sub>): δ 8.04 (d,1H), 7.15 (d, 1H).

b)Preparation of 2-amino-5,6 dichlorophenol

20 A mixture of 5,6-dichloro-2-nitrophenol(1.8 g, 8.7mmol) and tin (II) chloride (5.8 g, 26.1mmol) in ethanol(50mL) was heated at 80°C under argon. After 2 hours, the starting material had disappeared and the solution was allowed to cool down and then poured into ice. The pH was made slightly basic (pH7-8), by addition of solid NaOH, before being extracted with ethyl acetate. The organic phase was washed with brine, dried over MgSO<sub>4</sub> and filtered. 25 The solvent was evaporated and chromatography of the resulting solid on silica gel (4% MeOH/ CH<sub>2</sub>Cl<sub>2</sub>) gave the desired product(1.4 mg, 90 %). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 6.71 (d, 1H), 6.45 (d, 1H).

c)Preparation of N-[2-hydroxy-3,4-dichlorophenyl]-N'-[2-bromophenyl] urea

30 N-[2-Hydroxy-3,4-dichlorophenyl]-N'-[2-bromophenyl] urea was prepared from 2-amino-5,6-dichlorophenol (350mg, 2.00 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane(1/20) and filtering. (670mg, 89%). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 7.90 (d, 1H), 7.85 (d, 1H), 7.59 (d, 1H), 7.31 (t, 1H), 6.99 (t, 1H), 6.96 (d, 1H).

### Example 83

#### Preparation of N-[2-hydroxy-3-cyanophenyl]-N'-[2-bromophenyl] urea

a)Preparation of 2-nitro-6-cyanophenol

- 60 -

2-cyanophenol (2.38g, 20mmol) was dissolved in methylene chloride(40mL) followed by the addition of sodium nitrate (1.88g, 22mmol). The addition of sulfuric acid (20mL/ 3M) was then made, followed by addition of a catalytic amount of sodium nitrite. The mixture was allowed to stir. After 24 hours, the reaction mixture was diluted with methylene chloride and extracted with water. The organic layer was dried over  $\text{MgSO}_4$  and filtered. The solvent was evaporated and chromatography of the resulting solid on silica gel (4%MeOH/  $\text{CH}_2\text{Cl}_2$ ) gave the desired product(1.4 g, 42 %).  $^1\text{H}$  NMR ( $\text{CD}_3\text{COCD}_3$ ):  $\delta$  8.47 (d, 1H), 8.15 (d, 1H), 7.30 (t, 1H).

#### b)Preparation of 2-amino-6-cyanophenol

A mixture of 6-cyano-2-nitrophenol(600 mg, 1.0mmol) and tin (II) chloride (3.2 g, 14.4mmol) in acetic acid(50mL) was heated at  $80^\circ\text{C}$  under argon. After 2 hours, the starting material has disappeared and the solution was allowed to cool down and then poured into ice. The pH was made slightly basic (pH7-8), by addition of solid NaOH, before being extracted with ethyl acetate. The organic phase was washed with brine, dried over  $\text{MgSO}_4$  and filtered. The solvent was evaporated and chromatography of the resulting solid on silica gel (4%MeOH/  $\text{CH}_2\text{Cl}_2$ ) gave the desired product(365 mg, 75 %).  $^1\text{H}$  NMR ( $\text{CD}_3\text{OD}$ ):  $\delta$  6.92 (d, 1H), 6.85-6.69 (m, 2H).

#### c)Preparation of N-[2-hydroxy-3-cyanophenyl]-N'-[2-bromophenyl] urea

N-[2-Hydroxy-3-cyanophenyl]-N'-[2-bromophenyl] urea was prepared from 2-amino-6-cyanophenol (134mg, 1.00 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane(1/20) and filtering. (260mg, 78%).  $^1\text{H}$  NMR ( $\text{CD}_3\text{OD}$ ):  $\delta$  7.98 (d, 1H), 7.74 (d, 1H), 7.57 (d, 1H), 7.30 (t, 1H), 7.22 (d, 1H), 6.98 (t, 1H), 6.94 (t, 1H).

25

### Example 84

#### Preparation of N-[2-hydroxy-4-cyanophenyl]-N'-[2-bromophenyl] urea

##### a)Preparation of 2-nitro-5-cyanophenol

3-cyanophenol (2.38g, 20mmol) was dissolved in methylene chloride(40mL) followed by the addition of sodium nitrate (1.88g, 22mmol). The addition of sulfuric acid (20mL/ 3M) was then made, followed by addition of a catalytic amount of sodium nitrite. The mixture was allowed to stir. After 24 hours, the reaction mixture was diluted with methylene chloride and extracted with water. The organic layer was dried over  $\text{MgSO}_4$  and filtered. The solvent was evaporated and chromatography of the resulting solid on silica gel (4%MeOH/  $\text{CH}_2\text{Cl}_2$ ) gave the desired product(910 mg, 28 %).  $^1\text{H}$  NMR ( $\text{CD}_3\text{COCD}_3$ ):  $\delta$  8.30 (d, 1H), 7.67 (s, 1H), 7.49 (d, 1H).

##### b)Preparation of 2-amino-5-cyanophenol

A mixture of 5-cyano-2-nitrophenol(250 mg, 1.5mmol) and tin (II) chloride (3.2 g, 14.4mmol) in ethanol(50mL) was heated at  $80^\circ\text{C}$  under argon. After 2 hours, the starting

material has disappeared and the solution was allowed to cool down and then poured into ice. The pH was made slightly basic (pH7-8), by addition of solid NaOH, before being extracted with ethyl acetate. The organic phase was washed with brine, dried over  $\text{MgSO}_4$  and filtered. The solvent was evaporated and chromatography of the resulting solid on silica gel (4% MeOH/ $\text{CH}_2\text{Cl}_2$ ) gave the desired product (175 mg, 86 %).  $^1\text{H}$  NMR ( $\text{CD}_3\text{OD}$ ):  $\delta$  7.00 (d, 1H), 6.88 (s, 1H), 6.69 (d, 1H).

c) Preparation of N-[2-hydroxy-4-cyanophenyl]-N'-[2-bromophenyl] urea

N-[2-Hydroxy-4-cyanophenyl]-N'-[2-bromophenyl] urea was prepared from 2-amino-5-cyanophenol (170mg, 1.27 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane (1/20) and filtering (310mg, 74%).  $^1\text{H}$  NMR ( $\text{CD}_3\text{OD}$ ):  $\delta$  8.25 (d, 1H), 7.91 (d, 1H), 7.59 (d, 1H), 7.33 (t, 1H), 7.17 (d, 1H), 7.07 (s, 1H), 7.01 (t, 1H).

Example 85

15 Preparation of N-[2-hydroxy-4-cyanophenyl]-N'-[4-methoxyphenyl] urea

N-[2-Hydroxy-4-cyanophenyl]-N'-[4-methoxyphenyl] urea was prepared from 2-amino-5-cyanophenol (60mg, 0.45 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane (1/20) and filtering. (110mg, 86%).  $^1\text{H}$  NMR ( $\text{CD}_3\text{OD}$ ):  $\delta$  8.23 (d, 1H), 7.61-7.51 (m, 2H), 7.32 (d, 1H), 7.20 (d, 1H), 7.15 (d, 1H), 7.03 (s, 1H).

Example 86

Preparation of N-[2-hydroxy-4-cyanophenyl]-N'-[2-phenylphenyl] urea N-[2-Hydroxy-4-cyanophenyl]-N'-[2-phenylphenyl] urea was prepared from 2-amino-5-cyanophenol (170 mg, 1.27 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane (1/20) and filtering. (150mg, 85%).  $^1\text{H}$  NMR ( $\text{CD}_3\text{OD}$ ):  $\delta$  8.20 (d, 1H), 7.73 (d, 1H), 7.51-7.20 (m, 8H), 7.13 (d, 1H), 7.01 (s, 1H).

Example 87

30 Preparation of N-[2-hydroxy-4-cyanophenyl]-N'-[2-methylphenyl] urea

N-[2-Hydroxy-4-cyanophenyl]-N'-[2-methylphenyl] urea was prepared from 2-amino-5-cyanophenol (60mg, 0.45 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane (1/20) and filtering. (90mg, 75%).  $^1\text{H}$  NMR ( $\text{CD}_3\text{OD}$ ):  $\delta$  8.25 (d, 1H), 7.59 (d, 1H), 7.26-7.00 (m, 5H), 2.30 (s, 3H).

Example 88

Preparation of N-[2-hydroxy-4-cyanophenyl]-N'-[2-trifluoromethylphenyl] urea

- 62 -

N-[2-Hydroxy-4-cyanophenyl]-N'-[2-trifluoromethylphenyl] urea was prepared from 2-amino-5-cyanophenol (60mg, 0.45 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane(1/20) and filtering. (110mg, 76%). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 8.25 (d, 1H), 7.81 (d, 1H), 7.68 (d, 1H), 7.61 (t, 1H), 7.32 (t, 1H), 7.15 (dd, 1H), 7.09 (s, 1H).

**Example 89****Preparation of N-[2-hydroxy-4-cyanophenyl]-N'-[3-trifluoromethylphenyl] urea**

N-[2-hydroxy-4-cyanophenyl]-N'-[3-trifluoromethylphenyl] urea was prepared from 2-amino-5-cyanophenol (60mg, 0.45 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane(1/20) and filtering. (114mg, 79%). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 8.30 (d, 1H), 7.92 (s, 1H), 7.60 (d, 1H), 7.47 (t, 1H), 7.29 (d, 1H), 7.18 (dd, 1H), 7.06 (s, 1H).

**Example 90****Preparation of N-[2-hydroxy-4-cyanophenyl]-N'-[4-trifluoromethylphenyl] urea**

N-[2-Hydroxy-4-cyanophenyl]-N'-[4-trifluoromethylphenyl] urea was prepared from 2-amino-5-cyanophenol (60mg, 0.45 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane(1/20) and filtering. (108mg, 75%). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 8.31 (d, 1H), 7.68 (d, 2H), 7.59 (d, 2H), 7.20 (dd, 1H), 7.07 (s, 1H).

**Example 91****Preparation of N-[2-hydroxy-3-n-propylphenyl]-N'-[2-bromophenyl] urea****a) Preparation of 2-nitro-6-n-propylphenol**

2-n-propylphenol (5.00g, 36.8mmol) was dissolved in methylene chloride(40mL) followed by the addition of sodium nitrate (3.43g, 40.5mmol). The addition of sulfuric acid (45mL/ 3M) was then made, followed by addition of a catalytic amount of sodium nitrite. The mixture was allowed to stir. After 24 hours, the reaction mixture was diluted with methylene chloride and extracted with water. The organic layer was dried over MgSO<sub>4</sub> and filtered. The solvent was evaporated and chromatography of the resulting solid on silica gel (4% MeOH/ CH<sub>2</sub>Cl<sub>2</sub>) gave the desired product(3.2 mg, 48 %). <sup>1</sup>H NMR (CD<sub>3</sub>COCD<sub>3</sub>): δ 7.99 (d, 1H), 7.46 dd, 1H), 6.90 (t, 1H), 2.70 (t, 2H), 1.70 (m, 2H), 1.00 (t, 3H).

**b) Preparation of 2-amino-6-n-propylphenol**

To a solution of 2-nitro-6-n-propylphenol(2g, 11.0mmol) in methanol(100mL) was added 10% Pd/C (200 mg). The mixture was flushed with argon, then hydrogen was bubbled through the solution for 10 min. and a hydrogen atmosphere was maintained at balloon pressure overnight. The mixture was filtered through celite and the celite was washed with



methanol. The solvent was evaporated and chromatography of the resulting solid on silica gel (5% MeOH/ CH<sub>2</sub>Cl<sub>2</sub>) gave the desired product (1.50 g, 80.2 %). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 6.65 (m, 2H), 6.55 (t, 1H), 2.58 (t, 2H), 1.61 (m, 2H), 0.96 (t, 3H).

c) Preparation of N-[2-hydroxy-3-n-propylphenyl]-N'-[2-bromophenyl] urea

- 5 N-[2-Hydroxy-3-n-propyl phenyl]-N'-[2-bromo phenyl] urea was prepared from 2-amino-6-n-propyl phenol (302mg, 2.00 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane (1/20) and filtering. (640mg, 92%). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 8.00 (d, 1H), 7.58 (d, 1H), 7.32 (t, 1H), 7.26 (t, 1H), 6.96 (dd, 1H), 6.89 (t, 1H), 6.78 (d, 1H).

10

### Example 92

Preparation of N-[2-hydroxy-4-ethylphenyl]-N'-[2-bromophenyl] urea

a) Preparation of 2-nitro-5-ethylphenol

- 15 3-ethylphenol (5.00g, 41 mmol) was dissolved in methylene chloride (40 mL) followed by the addition of sodium nitrate (3.83g, 45 mmol). The addition of sulfuric acid (50mL/ 3M) was then made, followed by addition of a catalytic amount of sodium nitrite. The mixture was allowed to stir. After 24 hours, the reaction mixture was diluted with methylene chloride and extracted with water. The organic layer was dried over MgSO<sub>4</sub> and filtered. The solvent was evaporated and chromatography of the resulting solid on silica gel (4% MeOH/ CH<sub>2</sub>Cl<sub>2</sub>) gave the desired product (1.7 g, 25 %). <sup>1</sup>H NMR (CD<sub>3</sub>COCD<sub>3</sub>): δ 8.02 (d, 1H), 6.99 (s, 1H), 6.85 (d, 1H), 2.69 (q, 2H), 1.30 (t, 3H).

20

b) Preparation of 2-amino-5-ethylphenol

- 25 To a solution of 2-nitro-5-ethylphenol (1g, 6.4mmol) in methanol (250mL) was added 10% Pd/C (100 mg). The mixture was flushed with argon, then hydrogen was bubbled through the solution for 10 min. and a hydrogen atmosphere was maintained at balloon pressure overnight. The mixture was filtered through celite and the celite was washed with methanol. The solvent was evaporated and chromatography of the resulting solid on silica gel (5% MeOH/ CH<sub>2</sub>Cl<sub>2</sub>) gave the desired product (750 mg, 91 %). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 6.41-6.17 (m, 3H).

- 30 c) Preparation of N-[2-hydroxy-4-ethylphenyl]-N'-[2-bromophenyl] urea

- N-[2-Hydroxy-4-ethylphenyl]-N'-[2-bromo phenyl] urea was prepared from 2-amino-5-ethylphenol (274mg, 2.00 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane (1/20) and filtering. (520 mg, 77%). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 7.96 (d, 1H), 7.62 (s, 1H), 7.56 (d, 1H), 7.30 (t, 1H), 6.96 (t, 1H), 6.82 (d, 1H), 6.76 (d, 1H).

35

### Example 93

Preparation of N-[2-hydroxy 3-phenylaminocarbonyl phenyl]-N'-[2-bromophenyl] urea

## a) Preparation of 2-nitro-6-phenylaminocarbonylphenol

2-Phenylaminocarbonylphenol (5.00g, 23 mmol) was dissolved in methylene chloride (40mL) followed by the addition of sodium nitrate (2.20g, 25.5 mmol). The addition of sulfuric acid (30mL/ 3M) was then made, followed by addition of a catalytic amount of sodium nitrite. The mixture was allowed to stir. After 24 hours, the reaction mixture was diluted with methylene chloride and extracted with water. The organic layer was dried over  $\text{MgSO}_4$  and filtered. The solvent was evaporated and chromatography of the resulting solid on silica gel (4%MeOH/  $\text{CH}_2\text{Cl}_2$ ) gave the desired product (2.50 g, 42 %).  $^1\text{H}$  NMR ( $\text{CD}_3\text{COCD}_3$ ):  $\delta$  8.15 (d, 1H), 8.09 (d, 1H), 7.51 (d, 1H), 7.30 (d, 1H), 7.10 (t, 1H), 7.01 (t, 1H).

## b) Preparation of 2-amino-6-phenylaminocarbonylphenol

To a solution of 2-nitro-6-phenylaminocarbonylphenol (1g, 4.0 mmol) in methanol (250mL) was added 10% Pd/C (100 mg). The mixture was flushed with argon, then hydrogen was bubbled through the solution for 10 min. and a hydrogen atmosphere was maintained at balloon pressure overnight. The mixture was filtered through celite and the celite was washed with methanol. The solvent was evaporated and chromatography of the resulting solid on silica gel (5%MeOH/  $\text{CH}_2\text{Cl}_2$ ) gave the desired product (800 mg, 91 %).  $^1\text{H}$  NMR ( $\text{CD}_3\text{OD}$ ):  $\delta$  7.73-7.57 (m, 2H), 7.43-7.27 (m, 3H), 7.25-7.10 (m, 1H), 6.94 (t, 1H), 6.74 (t, 1H).

## c) Preparation of N-[2-hydroxy 3-phenylaminocarbonyl phenyl]-N'-[2-bromophenyl] urea

N-[2-hydroxy 3-Phenylaminocarbonyl phenyl]-N'-[2-bromo phenyl] urea was prepared from 2-amino-6-phenylaminocarbonylphenol (456mg, 2.00 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane (1/20) and filtering. (800mg, 94%).  $^1\text{H}$  NMR ( $\text{CD}_3\text{OD}$ ):  $\delta$  25 (d, 1H), 7.94 (d, 1H), 7.75-7.57 (m, 4H), 7.48-7.30 (m, 3H), 7.21 (t, 1H), 7.02 (dd, 1H), 6.92 (t, 1H).

Example 9430 Preparation of N-[2-hydroxy-3-cyano-4-methylphenyl]-N'-[2-bromophenyl] urea

## a) Preparation of the 2-nitro 5-methyl 6-bromo phenol

A solution of t-butyl amine (6.88 mL, 4.79 g, 2 equiv.) in methylene chloride was treated with bromine (1.67 mL, 5.2 g, 1 equiv.) at -20 °C. The flask was then cooled to -78 °C and the 2-nitro 5-methyl 6-bromo phenol (5 g, 1 equiv., in methylene chloride) was added drop-wise with vigorous stirring. The reaction mixture was slowly warmed to -30 °C for 1 h, then to -10 °C for 2 hours. The reaction mixture was then partitioned between methylene chloride and 5% aqueous acetic acid. The organic layer was dried over magnesium sulfate, filtered and concentrated *in vacuo*. The reaction mixture was purified by flash

chromatography(Ethyl acetate/ hexanes) to remove dibrominated species. The 2-nitro 4-bromo 5-methyl phenol was then selectively crystallized out of methylene chloride. A final silica gel column(5%ethyl acetate/ hexanes) yielded desired isomer in 90% purity.(1.05 g. 14%). <sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 7.95 (d, 1H, J = 10.0 Hz), 6.91 (d, 1H, J = 10.0 Hz), 2.52 (s, 3H).

5 b) Preparation of 2-nitro-5-methyl-6-cyanophenol

2-Nitro-5-methyl-6-bromophenol (100 mg, 0.433 mmol) was dissolved in dimethyl formamide (2mL) followed by the addition of triethylamine (0.175g, 1.73 mmol). The addition of a catalytic amount dimethylamino pyridine was then made, followed by addition of copper (I) cyanide (155mg, 1.73mmol). The mixture was allowed to stir at 80°C for 4 hours.

10 The solvent was evaporated and chromatography of the resulting solid on silica gel (2% MeOH/ CH<sub>2</sub>Cl<sub>2</sub>) gave the desired product (70 mg, 91 %). <sup>1</sup>H NMR (CD<sub>3</sub>COCD<sub>3</sub>): δ 8.30 (d, 1H), 7.15 (d, 1H), 2.61 (s, 3H).

c) Preparation of 2-amino-5-methyl 6-cyanophenol

15 A mixture of 5-cyano-2-nitrophenol(70 mg, 0.39mmol) and tin (II) chloride (265 mg, 1.18mmol) in ethanol(20mL) was heated at 80°C under argon. After 2 hours, the starting material has disappeared and the solution was allowed to cool down and then poured into ice. The pH was made slightly basic (pH7-8), by addition of solid NaOH, before being extracted with ethyl acetate. The organic phase was washed with brine, dried over MgSO<sub>4</sub> and filtered. The solvent was evaporated and chromatography of the resulting solid on silica gel (4% MeOH/ 20 CH<sub>2</sub>Cl<sub>2</sub>) gave the desired product(175 mg, 86 %). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 6.87 (d, 1H), 6.75 (d, 1H), 6.32 (s, 3H).

d) Preparation of N-[2-hydroxy 3-cyano 4-methyl phenyl]-N'-[2-bromophenyl] urea

25 N-[2-hydroxy 3-cyano 4-methyl phenyl]-N'-[2-bromophenyl] urea was prepared from 2-amino-5-methyl-6-cyano phenol (50mg, 0.34 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane(1/20) and filtering. (70mg, 60%). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 7.92 (d, 1H), 7.68 (d, 1H), 7.59 (d, 1H), 7.31 (t, 1H), 7.00 (t, 1H), 6.62 (t, 1H), 2.49 (s, (3H).

Example 95

30 Preparation of N-[2-hydroxy 4-Carboxyphenyl phenyl]-N'-[2-bromophenyl] urea

a)Preparation of 4-nitro-3-hydroxybenzophenone

35 3-Hydroxybenzophenone (3.00g, 15.1mmol) was dissolved in methylene chloride(40mL) followed by the addition of sodium nitrate (1.42g, 16.7mmol). The addition of sulfuric acid (25mL/ 3M) was then made, followed by addition of a catalytic amount of sodium nitrite. The mixture was allowed to stir. After 24 hours, the reaction mixture was diluted with methylene chloride and extracted with water. The organic layer was dried over MgSO<sub>4</sub> and filtered. The solvent was evaporated and chromatography of the resulting solid on silica gel (4% MeOH/ CH<sub>2</sub>Cl<sub>2</sub>) gave the desired product(1.10 g, 30 %). <sup>1</sup>H NMR

(CD<sub>3</sub>COCD<sub>3</sub>):  $\delta$  8.25 (d, 1H), 7.86 (d, 1H), 7.71 (m, 1H), 7.59 (d, 1H), 7.48 (s, 1H), 7.39 (dd, 1H).

b) Preparation of 4-amino-3-hydroxybenzophenone

5 A mixture of 4-nitro-3-hydroxybenzophenone (900 mg, 3.7 mmol) and tin (II) chloride (2.5 g, 11.1 mmol) in ethanol (50 mL) was heated at 80°C under argon. After 2 hours, the starting material has disappeared and the solution was allowed to cool down and then poured into ice. The pH was made slightly basic (pH 7-8), by addition of solid NaOH, before being extracted with ethyl acetate. The organic phase was washed with brine, dried over MgSO<sub>4</sub> and filtered. The solvent was evaporated and chromatography of the resulting solid on silica gel (4% MeOH/ CH<sub>2</sub>Cl<sub>2</sub>) gave the desired product (685 mg, 87 %). <sup>1</sup>H NMR (CD<sub>3</sub>OD):  $\delta$  7.65 (d, 2H), 7.55 (d, 1H), 7.49 (t, 2H), 7.26 (s, 1H), 7.16 (dd, 1H), 6.68 (d, 1H).

c) Preparation of N-[4-Carboxyphenyl-2-hydroxyphenyl]-N'-[2-bromophenyl] urea

N-[4-Carboxyphenyl-2-hydroxyphenyl]-N'-[2-bromophenyl] urea was prepared from 4-amino-3-hydroxybenzophenone (330 mg, 1.5 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane (1/20) and filtering. (490 mg, 79%). <sup>1</sup>H NMR (CD<sub>3</sub>OD):  $\delta$  8.40 (d, 1H), 8.09 (d, 1H), 7.83 (d, 2H), 7.65-7.60 (m, 4H), 7.48 (s, 1H), 7.43 (d, 1H), 7.35 (d, 1H), 7.10 (t, 1H).

20

Example 96

Preparation of N-[2-hydroxy 3-carboxyphenyl phenyl]-N'-[2-bromophenyl] urea

a) Preparation of 3-nitro-2-hydroxybenzophenone

2-Hydroxybenzophenone (3.00 g, 15.1 mmol) was dissolved in methylene chloride (40 mL) followed by the addition of sodium nitrate (1.42 g, 16.7 mmol). The addition of sulfuric acid (25 mL/ 3M) was then made, followed by addition of a catalytic amount of sodium nitrite. The mixture was allowed to stir. After 24 hours, the reaction mixture was diluted with methylene chloride and extracted with water. The organic layer was dried over MgSO<sub>4</sub> and filtered. The solvent was evaporated and chromatography of the resulting solid on silica gel (4% MeOH/ CH<sub>2</sub>Cl<sub>2</sub>) gave the desired product (1.60 g, 44 %). <sup>1</sup>H NMR (CD<sub>3</sub>COCD<sub>3</sub>):  $\delta$  8.30 (d, 1H), 7.86 (m, 3H), 7.71 (m, 1H), 7.78 (d, 1H), 7.56 (dd 2H), 7.24 (t, 1H).

b) Preparation of 3-amino-2-hydroxybenzophenone

35 A mixture of 3-nitro-2-hydroxybenzophenone (600 mg, 2.5 mmol) and tin (II) chloride (1.7 g, 7.5 mmol) in ethanol (50 mL) was heated at 80°C under argon. After 2 hours, the starting material had disappeared and the solution was allowed to cool down and then poured into ice. The pH was made slightly basic (pH 7-8), by addition of solid NaOH, before being extracted with ethyl acetate. The organic phase was washed with brine, dried over MgSO<sub>4</sub> and

filtered. The solvent was evaporated and chromatography of the resulting solid on silica gel (4% MeOH/ CH<sub>2</sub>Cl<sub>2</sub>) gave the desired product (490 mg, 92 %). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 7.65-7.40 (m, 5H), 6.98 (d, 1H), 6.86 (d, 1H), 6.67 (t, 1H).

c) Preparation of N-[2-hydroxy 3-carboxyphenyl phenyl]-N'-[2-bromophenyl] urea

5 N-[2-hydroxy 3-carboxyphenyl phenyl]-N'-[2-bromophenyl] urea was prepared from 3-amino-2-hydroxybenzophenone (250mg, 1.20 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane (1/20) and filtering. (200mg, 78%). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 8.35 (d, 1H), 7.96 (d, 1H), 7.72 (d, 2H), 7.65-7.50 (m, 4H), 7.35 (d, 1H), 7.30 (d, 1H), 7.01 (dd, 1H), 6.92 (t, 1H).

### Example 97

Preparation of N-[2-hydroxy 3-benzyloxy phenyl]-N'-[2-bromophenyl] urea

a) Preparation of 2-nitro-6-benzyloxy phenol

15 2-Benzyloxyphenol (5.00g, 25.0mmol) was dissolved in methylene chloride (40mL) followed by the addition of sodium nitrate (2.30g, 27.5mmol). The addition of sulfuric acid (31mL/ 3M) was then made, followed by addition of a catalytic amount of sodium nitrite. The mixture was allowed to stir. After 24 hours, the reaction mixture was diluted with methylene chloride and extracted with water. The organic layer was dried over MgSO<sub>4</sub> and filtered. The solvent was evaporated and chromatography of the resulting solid on silica gel (4% MeOH/ CH<sub>2</sub>Cl<sub>2</sub>) gave the desired product (2.6 g, 43 %). <sup>1</sup>H NMR (CD<sub>3</sub>COCD<sub>3</sub>): δ 7.70 (d, 1H), 7.50-7.28 (m, 5H), 7.14 (d, 1H), 6.92 (t, 1H), 5.21 (s, 2H).

b) Preparation of 2-amino-6-benzyloxy phenol

25 A mixture of 2-nitro-6-benzyloxy phenol (1.00 g, 4.10mmol) and tin (II) chloride (2.75 g, 12.2 mmol) in ethanol (150mL) was heated at 80°C under argon. After 2 hours, the starting material had disappeared and the solution was allowed to cool down and then poured into ice. The pH was made slightly basic (pH 7-8), by addition of solid NaOH, before being extracted with ethyl acetate. The organic phase was washed with brine, dried over MgSO<sub>4</sub> and filtered. The solvent was evaporated and chromatography of the resulting solid on silica gel (4% MeOH/ CH<sub>2</sub>Cl<sub>2</sub>) gave the desired product (1.35 g, 88 %). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 7.46 (d, 2H), 7.40-7.35 (m, 5H), 6.55 (d, 1H), 6.40 (d, 1H), 5.10 (s, 2H).

b) Preparation of N-[2-hydroxy 3-benzyloxy phenyl]-N'-[2-bromophenyl] urea

35 N-[3-benzyloxy-2-hydroxyphenyl]-N'-[2-bromophenyl] urea was prepared from 2-nitro-6-benzyloxy phenol (430mg, 2.00 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane (1/20) and filtering. (630mg, 76%). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 7.93 (d, 1H), 7.58 (d, 1H), 7.54-7.42 (m, 3H), 7.40-7.25 (m, 4H), 7.00 (t, 1H), 6.69 (d, 2H), 5.16 (s, 2H).

### Example 98

Preparation of N-3-[2-hydroxy-5-indanone]-N'-[2-bromophenyl] urea

## a) Preparation of 2-hydroxy-3-nitro-5-indanone

2-Hydroxy-5-indanone (3.00g, 20.0mmol) was dissolved in methylene chloride (40mL) followed by the addition of sodium nitrate (1.95g, 21.0mmol). The addition of sulfuric acid (25mL/ 3M) was then made, followed by addition of a catalytic amount of sodium nitrite. The mixture was allowed to stir. After 24 hours, the reaction mixture was diluted with methylene chloride and extracted with water. The organic layer was dried over  $\text{MgSO}_4$  and filtered. The solvent was evaporated and chromatography of the resulting solid on silica gel (4% MeOH/  $\text{CH}_2\text{Cl}_2$ ) gave the desired product (1.5 g, 39 %).  $^1\text{H}$  NMR ( $\text{CD}_3\text{COCD}_3$ ):  $\delta$  7.70 (d, 1H), 7.04 (d, 1H), 3.04 (d, 2H), 2.74 (d, 2H).

## b) Preparation of 3-amino-2-hydroxy-5-indanone

A mixture of 2-hydroxy-3-nitro-5-indanone (1.50 g, 7.80mmol) and tin (II) chloride (5.25 g, 23.3 mmol) in ethanol (150mL) was heated at  $80^\circ\text{C}$  under argon. After 2 hours, the starting material had disappeared and the solution was allowed to cool down and then poured into ice. The pH was made slightly basic (pH 7-8), by addition of solid NaOH, before being extracted with ethyl acetate. The organic phase was washed with brine, dried over  $\text{MgSO}_4$  and filtered. The solvent was evaporated and chromatography of the resulting solid on silica gel (4% MeOH/  $\text{CH}_2\text{Cl}_2$ ) gave the desired product (1.00 g, 79 %).  $^1\text{H}$  NMR ( $\text{CD}_3\text{OD}$ ):  $\delta$  6.85 (d, 1H), 6.45 (d, 1H), 2.95 (d, 2H), 2.60 (d, 2H).

## c) Preparation N-3-[2-hydroxy-5-indanone]-N'-[2-bromophenyl] urea

N-[2-Hydroxy-5-indanone]-N'-[2-bromophenyl] urea was prepared from 3-amino-2-hydroxy-5-indanone (326mg, 2.00 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane (1/20) and filtering (610mg, 85%).  $^1\text{H}$  NMR ( $\text{CD}_3\text{OD}$ ):  $\delta$  7.92 (d, 1H), 7.65 (m, 2H), 7.45 (t, 1H), 7.09 (t, 1H), 7.00 (d, 1H), 2.90 (d, 2H), 2.66 (d, 2H).

Example 99Preparation of (E)-N-[4-[2-(Methoxycarbonyl) ethenyl]-2-hydroxyphenyl]-N'-[2-bromophenyl] urea

30

## a) Preparation of 4-nitro-3-hydroxycinnamic acid

3-Hydroxycinnamic acid (3.00g, 18.3 mmol) was dissolved in methylene chloride (40mL) followed by the addition of sodium nitrate (1.70 g, 26.1mmol). The addition of sulfuric acid (25 mL/ 3M) was then made, followed by addition of a catalytic amount of sodium nitrite. The mixture was allowed to stir. After 24 hours, the reaction mixture was diluted with methylene chloride and extracted with water. The organic layer was dried over  $\text{MgSO}_4$  and filtered. The solvent was evaporated and chromatography of the resulting solid on

35

silica gel (4%MeOH/ CH<sub>2</sub>Cl<sub>2</sub>) gave the desired product(1.0 g, 26 %). <sup>1</sup>H NMR (CD<sub>3</sub>COCD<sub>3</sub>): δ 8.07 (d, 1H), 7.69 (d, 1H), 7.51 (s, 1H), 7.46 (d, 2H), 6.75 (d,1H).

b) Preparation of 4-nitro-3-hydroxymethylcinnamate

4-Nitro-3-hydroxycinnamic acid was stirred in excess methanol with a catalytic amount of sulfuric acid. The solvent was evaporated and chromatography of the resulting solid on silica gel (4%MeOH/ CH<sub>2</sub>Cl<sub>2</sub>) gave the desired product(1.0 g, 94 %). <sup>1</sup>H NMR (CD<sub>3</sub>COCD<sub>3</sub>): δ 8.17 (d, 1H), 7.69 (d, 1H), 7.52 (s, 1H), 7.45 (d, 2H), 6.75 (d,1H), 3.80 (s, 3H).

c)Preparation of 4-amino-3-hydroxymethylcinnamate

A mixture of 4-nitro-3-hydroxymethylcinnamate (1.0 g, 4.50mmol) and tin (II) chloride (3.0 g, 13.4 mmol) in ethanol(50mL) was heated at 80°C under argon. After 2 hours, the starting material had disappeared and the solution was allowed to cool down and then poured into ice. The pH was made slightly basic (pH7-8), by addition of solid NaOH, before being extracted with ethyl acetate. The organic phase was washed with brine, dried over MgSO<sub>4</sub> and filtered. The solvent was evaporated and chromatography of the resulting solid on silica gel (4%MeOH/ CH<sub>2</sub>Cl<sub>2</sub>) gave the desired product (650 mg, 75 %). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 7.50 (d,1H), 6.94 (s, 1H), 6.89 (d, 1H), 6.68 (d, 1H), 6.18 (d, 1H), 3.74 (s, 3H).

d)Preparation (E)-N-[4-[2-(Methoxycarbonyl) ethenyl]-2-hydroxyphenyl]-N'-[2-bromophenyl] urea

(E)-N-[4-[2-(Methoxycarbonyl) ethenyl]-2-hydroxyphenyl]-N'-[2-bromophenyl] urea was prepared from 4-amino-3-hydroxymethylcinnamate (250mg, 1.3 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane(1/20) and filtering. (300mg, 59%). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 8.24 (d,1H), 8.05 (d, 1H), 7.69 (d, 1H), 7.65 (d, 1H), 7.42 (t, 1H), 7.21 (s, 1H), 7.19 (d, 1H), 7.10 (t, 1H), 6.45 (d,1H) 3.81 (s, 3H).

Example 100

Preparation of (E)-N-[3-[2-(Methoxycarbonyl) ethenyl]-2-hydroxyphenyl]-N'-[2-bromophenyl] urea N'-[2-bromophenyl] urea

a)Preparation of 3-nitro-2-hydroxycinnamic acid

2-Hydroxycinnamic acid (3.00g, 18.3 mmol) was dissolved in methylene chloride(40mL) followed by the addition of sodium nitrate (2.21 g, 26.1mmol). The addition of sulfuric acid (30 mL/ 3M) was then made, followed by addition of a catalytic amount of sodium nitrite. The mixture was allowed to stir. After 24 hours, the reaction mixture was diluted with methylene chloride and extracted with water. The organic layer was dried over MgSO<sub>4</sub> and filtered. The solvent was evaporated and chromatography of the resulting solid on silica gel (4%MeOH/ CH<sub>2</sub>Cl<sub>2</sub>) gave the desired product(2.0 g, 52 %). <sup>1</sup>H NMR (CD<sub>3</sub>COCD<sub>3</sub>): δ 8.21 (d, 1H), 8.16 (d, 1H), 8.05 (d, 1H), 7.19 (t, 1H), 6.72 (d, 1H)

## b) Preparation of 3-nitro-2-hydroxymethylcinnamate

3-nitro-2-hydroxycinnamic acid was stirred in excess methanol with a catalytic amount of sulfuric acid. The solvent was evaporated and chromatography of the resulting solid on silica gel (4% MeOH/ CH<sub>2</sub>Cl<sub>2</sub>) gave the desired product (1.0 g, 94 %). <sup>1</sup>H NMR (CD<sub>3</sub>COCD<sub>3</sub>):

5 δ 8.25 (d, 1H), 7.8.15 (d, 1H), 8.06 (s, 1H), 7.20 (t, 2H), 6.76 (d, 1H), 3.80 (s, 3H).

## c) Preparation of 3-amino-2-hydroxymethylcinnamate

A mixture of 3-nitro-2-hydroxymethylcinnamate (1.0 g, 4.5 mmol) and tin (II) chloride (3.0 g, 13.4 mmol) in ethanol (50 mL) was heated at 80°C under argon. After 2 hours, the starting material had disappeared and the solution was allowed to cool down and then poured

10 into ice. The pH was made slightly basic (pH 7-8), by addition of solid NaOH, before being extracted with ethyl acetate. The organic phase was washed with brine, dried over MgSO<sub>4</sub> and filtered. The solvent was evaporated and chromatography of the resulting solid on silica gel (4% MeOH/ CH<sub>2</sub>Cl<sub>2</sub>) gave the desired product (700 mg, 81 %). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 8.04 (d, 1H), 6.93 (d, 1H), 6.79 (d, 1H), 6.71 (t, 1H), 6.43 (d, 1H), 3.72 (s, 3H).

## 15 d) Preparation (E)-N-[3-[2-(Methoxycarbonyl) ethenyl]-2-hydroxyphenyl]-N'-[2-bromophenyl] urea

(E)-N-[3-[2-(Methoxycarbonyl) ethenyl]-2-hydroxyphenyl]-N'-[2-bromophenyl] urea was prepared from 3-amino-2-hydroxymethylcinnamate (100 mg, 0.52 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene

20 chloride/ hexane (1/20) and filtering. (150 mg, 74%). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 8.10 (d, 1H), 8.00 (d, 1H), 7.69 (d, 1H), 7.65 (d, 1H), 7.42 (t, 1H), 7.38 (t, 1H), 7.32 (d, 1H), 7.05 (t, 1H) 6.55 (d, 1H) 3.81 (s, 3H).

Example 10125 Preparation of (E)-N-[3-[2-(Aminocarbonyl) ethenyl]-2-hydroxyphenyl]-N'-[2-bromophenyl] urea N'-[2-bromophenyl] urea

## a) Preparation of 2-hydroxycinnamide

2-Hydroxycinnamic acid (2.00 g, 12.3 mmol) was dissolved in dimethyl formamide (10 mL) followed by the addition of benzotriazol-1-yloxy-

30 tris(dimethylamino)phosphonium hexafluorophosphate (5.4 g, 12.3 mmol) and triethylamine (1.7 mL, 12.3 mmol). Ammonia gas was bubbled into the reaction mixture for 30 minutes. The mixture was allowed to stir for 24 hours, the reaction mixture was diluted with methylene chloride and extracted with water. The organic layer was dried over MgSO<sub>4</sub> and filtered. The solvent was evaporated and chromatography of the resulting solid on silica gel (4% MeOH/

35 CH<sub>2</sub>Cl<sub>2</sub>) gave the desired product (1.5 g, 75 %).

## b) Preparation of 3-nitro-2-hydroxycinnamide

2-Hydroxycinnamide (750 mg, 4.6 mmol) was dissolved in methylene chloride (40 mL) followed by the addition of sodium nitrate (430 mg, 5.1 mmol). The addition of sulfuric acid



- 71 -

(7 mL/ 3M) was then made, followed by addition of a catalytic amount of sodium nitrite. The mixture was allowed to stir. After 24 hours, the reaction mixture was diluted with methylene chloride and extracted with water. The organic layer was dried over  $\text{MgSO}_4$  and filtered. The solvent was evaporated and chromatography of the resulting solid on silica gel (4% MeOH/  $\text{CH}_2\text{Cl}_2$ ) gave the desired product (350 mg, 36 %).  $^1\text{H}$  NMR ( $\text{CD}_3\text{COCD}_3$ ):  $\delta$  8.19 (d, 1H), 8.02 (d, 1H), 7.88 (d, 1H), 7.15 (t, 1H), 6.84 (d, 1H).

c) Preparation of 3-amino-2-hydroxycinnamide

A mixture of 3-nitro-2-hydroxymethylcinnamate (350 mg, 1.7 mmol) and tin (II) chloride (3.0 g, 13.4 mmol) in ethanol (50 mL) was heated at  $80^\circ\text{C}$  under argon. After 2 hours, the starting material had disappeared and the solution was allowed to cool down and then poured into ice. The pH was made slightly basic (pH 7-8), by addition of solid NaOH, before being extracted with ethyl acetate. The organic phase was washed with brine, dried over  $\text{MgSO}_4$  and filtered. The solvent was evaporated and chromatography of the resulting solid on silica gel (4% MeOH/  $\text{CH}_2\text{Cl}_2$ ) gave the desired product (244 mg, 80%).

d) Preparation of (E)-N-[3-[2-(Aminocarbonyl) ethenyl]-2-hydroxyphenyl]-N'-[2-bromophenyl] urea

(E)-N-[3-[2-(Aminocarbonyl) ethenyl]-2-hydroxyphenyl]-N'-[2-bromophenyl] urea was prepared from 3-amino-2-hydroxycinnamide (100 mg, 0.56 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane (1/20) and filtering. (110 mg, 52%).  $^1\text{H}$  NMR ( $\text{CD}_3\text{OD}$ ):  $\delta$  8.00 (d, 1H), 7.90 (d, 1H), 7.63 (d, 1H), 7.55 (d, 1H), 7.35 (m, 2H), 7.05 (t, 1H), 6.95 (t, 1H), 6.70 (d, 1H).

### Example 102

Preparation of (E)-N-[4-[2-(Aminocarbonyl) ethenyl]-2-hydroxyphenyl]-N'-[2-bromophenyl] urea

a) Preparation of 3-hydroxycinnamide

3-Hydroxycinnamic acid (2.00 g, 12.3 mmol) was dissolved in dimethyl formamide (10 mL) followed by the addition of benzotriazol-1-yloxy-tris(dimethylamino)phosphonium hexafluorophosphate (5.4 g, 12.3 mmol) and triethylamine (1.7 mL, 12.3 mmol). Ammonia gas was bubbled into the reaction mixture for 30 minutes. The mixture was allowed to stir for 24 hours, the reaction mixture was diluted with methylene chloride and extracted with water. The organic layer was dried over  $\text{MgSO}_4$  and filtered. The solvent was evaporated and chromatography of the resulting solid on silica gel (4% MeOH/  $\text{CH}_2\text{Cl}_2$ ) gave the desired product (1.3 g, 65 %).

b) Preparation of 4-nitro-3-hydroxycinnamide

3-Hydroxycinnamide (750 mg, 4.6 mmol) was dissolved in methylene chloride (40 mL) followed by the addition of sodium nitrate (430 mg, 5.1 mmol). The addition of sulfuric acid (7 mL/ 3M) was then made, followed by addition of a catalytic amount of sodium nitrite. The

- 72 -

mixture was allowed to stir. After 24 hours, the reaction mixture was diluted with methylene chloride and extracted with water. The organic layer was dried over  $\text{MgSO}_4$  and filtered. The solvent was evaporated and chromatography of the resulting solid on silica gel (4% MeOH/  $\text{CH}_2\text{Cl}_2$ ) gave the desired product (240 mg, 25 %).  $^1\text{H}$  NMR ( $\text{CD}_3\text{COCD}_3$ ):  $\delta$  8.09 (d, 1H),

5 7.49 (d, 1H), 7.26 (s, 1H), 7.16 (d, 1H), 6.71 (d, 1H)

c) Preparation of 4-amino-2-hydroxycinnamide

A mixture of 4-nitro-3-hydroxymethylcinnamate (300 mg, 1.40 mmol) and tin (II) chloride (980 mg, 4.30 mmol) in ethanol (50 mL) was heated at  $80^\circ\text{C}$  under argon. After 2 hours, the starting material had disappeared and the solution was allowed to cool down and then poured into ice. The pH was made slightly basic (pH 7-8), by addition of solid NaOH. before being extracted with ethyl acetate. The organic phase was washed with brine, dried over  $\text{MgSO}_4$  and filtered. The solvent was evaporated and chromatography of the resulting solid on silica gel (4% MeOH/  $\text{CH}_2\text{Cl}_2$ ) gave the desired product (200 mg, 74 %).

d) Preparation (E)-N-[3-[2-(Aminocarbonyl) ethenyl]-2-hydroxyphenyl]-N'-[2-bromophenyl] urea

(E)-N-[3-[2-(Aminocarbonyl) ethenyl]-2-hydroxyphenyl]-N'-[2-bromophenyl] urea was prepared from 4-amino-2-hydroxycinnamide (100 mg, 0.56 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane (1/20) and filtering. (125 mg, 54%).  $^1\text{H}$  NMR ( $\text{CD}_3\text{OD}$ ):  $\delta$  8.05 (d, 1H), 7.92 (d, 1H), 7.60 (d, 1H), 7.45 (d, 1H), 7.35 (t, 1H), 7.05 (m, 2H), 6.50 (d, 1H).

### Example 103

#### Preparation of N-[2-hydroxy 4-(phenyl amino carboxy) phenyl]-N'-[2-bromophenyl] urea

N-[2-hydroxy 4-(phenyl amino carboxy) phenyl]-N'-[2-bromophenyl] urea was prepared from 5-(phenyl amino carboxy) 2-amino phenol (0.50 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane (1/20) and filtering. (150 mg, 70%).  $^1\text{H}$  NMR ( $\text{CD}_3\text{OD}$ ):  $\delta$  8.25 (d, 1H), 8.00 (d, 1H), 7.75 (d, 2H), 7.64 (d, 1H), 7.50 (d, 2H), 7.41 (m, 3H), 7.16 (t, 1H), 7.05 (t, 1H).

### Example 104

#### Preparation of N-[4-aminocarbonyl]-2-hydroxyphenyl]-N'-[2-bromophenyl] urea

N-[4-Aminocarbonyl]-2-hydroxyphenyl]-N'-[2-bromophenyl] urea was prepared from 5-aminocarbonyl-2-amino phenol (304 mg, 0.50 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane (1/20) and filtering. (440 mg, 62%).  $^1\text{H}$  NMR ( $\text{CD}_3\text{OD}$ ):  $\delta$  8.09 (d, 1H), 7.91 (d, 1H), 7.60 (d, 1H), 7.45 (m, 3H), 7.00 (d, 1H).

- 73 -

Example 105Preparation of N-(2-Hydroxy-3,5,6-trifluorophenyl)-N'-(2-bromophenyl)urea

N-(2-Hydroxy-3,5,6-trifluorophenyl)-N'-(2-bromophenyl)urea was prepared from 3,5,6-trifluoro-2-hydroxyaniline (83 mg, 0.51 mmol) and 2-(bromophenyl)isocyanate (100 mg, 0.53 mmol) according to the procedure in General Method B. The product was purified by preparation thin layer chromatography. EI-MS m/z 359 (M-H)<sup>+</sup>.

Example 106Preparation of N-(2-Hydroxy-3-fluoro-4-trifluoromethylphenyl)-N'-(2-bromophenyl)urea

N-(2-Hydroxy-3-fluoro-4-trifluoromethylphenyl)-N'-(2-bromophenyl)urea was prepared from 4-trifluoromethyl-3-fluoro-2-hydroxyaniline (239 mg, 1.2 mmol) and 2-(bromophenyl)isocyanate (243 mg, 1.2 mmol) according to the procedure in General Method B. Removal of solvent under reduced pressure and chromatography of the resulting solid on silica gel (hexane:ethyl acetate) gave the title compound (20 mg, 4%). EI-MS m/z 391 (M-H)<sup>+</sup>.

Example 107Preparation of N-(2-Hydroxy-3-iodophenyl)-N'-(2-bromophenyl)urea

N-(2-Hydroxy-3-iodophenyl)-N'-(2-bromophenyl)urea was prepared from 3-iodo-2-hydroxyaniline (200 mg, 0.85 mmol) and 2-(bromophenyl)isocyanate (169 mg, 0.85 mmol) according to the procedure in General Method B. Removal of solvent under reduced pressure and chromatography of the resulting solid on silica gel (hexane:ether) gave the title compound (40 mg, 11%). <sup>1</sup>H NMR (DMSO): δ 9.45 (s, 1H), 9.15 (s, 1H), 8.8 (s, 1H), 7.95 (d, 1H), 7.8 (d, 1H), 7.65 (d, 1H), 7.4 (d, 1H), 7.3 (t, 1H), 7.0 (t, 1H), 6.65 (t, 1H).

Example 108Preparation of N-[2-[[[2-(trifluoromethyl)phenyl]sulfonyl]amino]phenyl]-N'-(2-bromophenyl)ureaa) Preparation of [2-[2-(trifluoromethyl)phenyl](sulfonamido)aniline]

The title compound was prepared according to General Method C using 2-(trifluoromethyl)benzenesulfonyl chloride (1 equiv.). The product was purified by chromatography on silica gel (methylene chloride:methanol) (1.04 g, 33%). EI-MS m/z 317 (M+H)<sup>+</sup>.

b) Preparation of N-[2-[[[2-(trifluoromethyl)phenyl]sulfonyl]amino]phenyl]-N'-(2-bromophenyl)urea

The title compound was prepared using [2-[2-(trifluoromethyl)phenyl](sulfonamido)aniline] (1.04 g, 3.2 mmol) and 2-(bromophenyl)isocyanate (652 mg, 3.2 mmol) according to General Method B. The solvent was evaporated to give the desired urea (1.03 g, 61%). EI-MS m/z 514 (M+H)<sup>+</sup>.

Example 109Preparation of N-(2-Bromophenyl)-N'-[2-(dimethylaminosulfonylamino)phenyl]urea

- 5 a) Preparation of [2-[1,1-(dimethylamino)]sulfonamido]aniline]

The title compound was prepared according to General Method C using dimethylsulfamoyl chloride (1 equiv.). The product was purified by chromatography on silica gel (methylene chloride:methanol). ES-MS  $m/z$  216 (M+H)<sup>+</sup>.

- b) Preparation of N-(2-Bromophenyl)-N'-[2-(dimethylaminosulfonylamino)phenyl]urea

- 10 The title compound was prepared from [2-[1,1-(dimethylamino)]sulfonamido]aniline (137 mg, 0.6 mmol) and 2-(bromophenyl)isocyanate (126 mg, 0.6 mmol) according to General Method B. The solvent was evaporated and chromatography on silica gel (ethyl acetate:hexane) gave the desired urea. EI-MS  $m/z$  413 (M+H)<sup>+</sup>

- 15 Example 110

Preparation of N-[2-(Phenethylsulfonylamino)phenyl]-N'-(2-bromophenyl)urea

- [2-(Phenethylsulfonamido) aniline] (example 60, 300mg, 1.09 mmol) was placed in a Parr shaker bottle containing palladium (180 mg) under an argon stream. Methanol (150 mL) was added and the container placed on a Parr shaker (55 psi) for several hours. The reaction mixture was filtered through Celite and the filtrate was evaporated to give the desired aniline (269 mg, 90%). EI-MS  $m/z$  277 (M+H)<sup>+</sup>.

- 20 b) Preparation of N-[2-(Phenethylsulfonylamino)phenyl]-N'-(2-bromophenyl)urea

- The title compound was prepared from [2-(phenethylsulfonamido) aniline] (269 mg, 0.97 mmol) and 2-(bromophenyl)isocyanate (193 mg, 0.97 mmol) according to General Method B. The desired urea was precipitated out of toluene/hexane (384 mg, 78%). EI-MS  $m/z$  472 (M-H)<sup>+</sup>.

- 25 Example 111

Preparation of N-[2-[2-(2-acetamido-4-methylthiazol-5-yl)sulfonylamino]phenyl]-N'-(2-bromophenyl)urea

- 30 a) Preparation of [2-[2-(2-acetamido-4-methyl-5-thiazole)sulfonamido]aniline]

The title compound was prepared using 2-acetamido-4-methyl-5-thiazolesulfonyl chloride (1 equiv.) according to General Method C. A solid precipitated from the reaction mixture and was filtered to give the desired aniline (1.68 g, 52%). ES-MS  $m/z$  327 (M+H)<sup>+</sup>.

- 35 b) Preparation of N-[2-[2-(2-acetamido-4-methylthiazol-5-yl)sulfonylamino]phenyl]-N'-(2-bromophenyl)urea

The title compound was prepared from [2-[2-(2-acetamido-4-methyl-5-thiazole)sulfonamido]aniline] (1.68 g, 5.14 mmol) and 2-(bromophenyl)isocyanate

- 75 -

(1.02 g, 5.14 mmol) according to General Method B. The product was precipitated from ethyl acetate/hexane (220 mg, 8%). EI-MS  $m/z$  524 ( $M+H$ )<sup>+</sup>.

#### Example 112

- 5 Preparation of N-[2-hydroxy-4-cyanophenyl]-N'-[4-phenylphenyl] urea N-[2-Hydroxy-4-cyanophenyl]-N'-[4-phenylphenyl] urea was prepared from 2-amino-5-cyanophenol (60mg, 0.45 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane(1/20) and filtering. (135 mg, 75%). <sup>1</sup>H NMR (CD<sub>3</sub>OD):  $\delta$  8.33 (d, 1H), 7.71-7.29 (m, 9H), 7.25 (d, 1H), 7.12 (s, 1H).

10

#### Example 113

##### Preparation of N-[2-hydroxy-4-cyanophenyl]-N'-[2,3-dichlorophenyl] urea

- = N-[2-Hydroxy-4-cyanophenyl]-N'-[2,3 dichlorophenyl] urea was prepared from 2-amino-5-cyanophenol (60mg, 0.45 mmol) according to the procedure in General Method B.  
15 The product was purified by precipitation from methylene chloride/ hexane(1/20) and filtering. (125mg, 86%). <sup>1</sup>H NMR (CD<sub>3</sub>OD):  $\delta$  8.27 (d, 1H), 8.15 (m, 1H), 7.39-7.20 (m, 2H), 7.16 (d, 1H), 7.06 (s, 1H).

#### Example 114

- 20 Preparation of N-[2-hydroxy-4-cyanophenyl]-N'-[2-methoxyphenyl] urea

N-[2-Hydroxy-4-cyanophenyl]-N'-[2-methoxyphenyl] urea was prepared from 2-amino-5-cyanophenol (60mg, 0.45 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane(1/20) and filtering (105mg, 83%). <sup>1</sup>H NMR (CD<sub>3</sub>OD):  $\delta$  8.26 (d, 1H), 8.02 (d, 1H), 7.14 (d, 1H), 7.05 (s, 1H), 7.00-6.83 (m, 3H), 3.84 (s, 3H).

25

#### Example 115

##### Preparation of N-[2-hydroxy-4-cyanophenyl]-N'-[3-methoxyphenyl] urea

- 30 N-[2-Hydroxy-4-cyanophenyl]-N'-[3-methoxyphenyl] urea was prepared from 2-amino-5-cyanophenol (60mg, 0.45 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane(1/20) and filtering (102mg, 80%). <sup>1</sup>H NMR (CD<sub>3</sub>OD):  $\delta$  8.25 (d, 1H), 7.25-7.08 (m, 3H), 7.04 (s, 1H), 6.90 (t, 1H), 6.58 (d, 1H).

35

#### Example 116

##### Preparation of N-[2-hydroxy-5-fluorophenyl]-N'-[2-bromophenyl] urea

a)Preparation of 2-amino-4-fluorophenol

- 76 -

A mixture of 4-fluoro-2-nitrophenol (1 g, 4.64 mmol) and tin (II) chloride (5.4 g, 24.2 mmol) in ethanol (50 mL) was heated at 80°C under argon. After 2 hours, the starting material had disappeared and the solution was allowed to cool down and then poured into ice. The pH is made slightly basic (pH 7-8), by addition of solid NaOH, before being extracted with ethyl acetate. The organic phase was washed with brine, dried over MgSO<sub>4</sub> and filtered. The solvent was evaporated and chromatography of the resulting solid on silica gel (4% MeOH/CH<sub>2</sub>Cl<sub>2</sub>) gave the desired product (622 mg, 85 %). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 6.51 (dd, 1H), 6.32 (dd, 1H), 6.17 (ddd, 1H).

b) Preparation of N-[2-hydroxy-5-fluorophenyl]-N'-[2-bromophenyl] urea

N-[2-Hydroxy-5-fluorophenyl]-N'-[2-bromophenyl] urea was prepared from 2-amino-6-fluoro phenol (254 mg, 2.00 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane (1/20) and filtering. (520 mg, 80%). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 7.88 (d, 1H), 7.79 (dd, 1H), 7.57 (d, 1H), 7.31 (t, 1H), 7.00 (t, 1H), 6.76 (dd, 1H), 6.57 (ddd, 1H).

### Example 117

Preparation of N-[2-hydroxy-5-trifluoromethylphenyl]-N'-[2-bromophenyl] urea

a) Preparation of 2-amino-4-trifluoromethylphenol

A mixture of 4-trifluoromethyl-2-nitrophenol (1.0 g, 4.8 mmol) and tin (II) chloride (5.4 g, 24.2 mmol) in ethanol (150 mL) was heated at 80°C under argon. After 2 hours, the starting material had disappeared and the solution was allowed to cool down and then poured into ice. The pH was made slightly basic (pH 7-8), by addition of solid NaOH, before being extracted with ethyl acetate. The organic phase was washed with brine, dried over MgSO<sub>4</sub> and filtered. The solvent was evaporated and chromatography of the resulting solid on silica gel (4% MeOH/CH<sub>2</sub>Cl<sub>2</sub>) gave the desired product (708 mg, 83 %). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 6.87 (s, 1H), 6.80 (d, 1H), 6.69 (d, 1H).

b) Preparation of N-[2-hydroxy-5-trifluoromethylphenyl]-N'-[2-bromophenyl] urea

N-[2-hydroxy-5-trifluoromethylphenyl]-N'-[2-bromophenyl] urea was prepared from 2-amino-4-trifluoromethylphenol (354 mg, 2.00 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane (1 equiv./20 equiv.) and filtering. (490 mg, 65 %). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 8.40 (s, 1H), 7.94 (d, 1H), 7.60 (d, 1H), 7.35 (t, 1H), 7.18 (d, 1H), 7.03 (t, 1H), 6.95 (d, 1H).

### Example 118

Preparation of N-[2-hydroxyphenyl]-N'-[2-bromophenyl] urea

N-[2-hydroxyphenyl]-N'-[2-bromo phenyl] urea was prepared from 2-amino-phenol (141 mg, 1.30 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane (1/20) and filtering. (300 mg, 75 %).

<sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 8.05 (d, 1H), 7.49 (d, 1H), 7.25 (t, 2H), 6.96 (t, 1H), 6.90 (t, 2H), 6.68 (t, 1H).

### Example 119

#### 5 Preparation of N-[trans-3-styryl-2-hydroxy phenyl]-N'-[2-bromophenyl] urea

##### a) Preparation of trans-6-styryl-2-nitrophenol

Trans-2-styrylphenol (500 mg, 2.55 mmol) was dissolved in methylene chloride (40 mL) followed by the addition of sodium nitrate (240 mg, 2.81 mmol). The addition of sulfuric acid (3 mL of 3M) was then made, followed by addition of a catalytic amount of sodium nitrite.

10 The mixture was allowed to stir. After 24 hours, the reaction mixture was diluted with methylene chloride and extracted with water. The organic layer was dried over MgSO<sub>4</sub> and filtered. The solvent was evaporated and chromatography of the resulting solid on silica gel (4% MeOH/ CH<sub>2</sub>Cl<sub>2</sub>) gave the desired product (200 mg, 36 %). <sup>1</sup>H NMR (CD<sub>3</sub>COCD<sub>3</sub>): δ 8.05 (d, 1H), 7.90 (d, 2H), 7.65-7.20 (m, 7H), 7.00 (t, 1H).

##### 15 b) Preparation of trans-6-styryl-2-aminophenol

A mixture of trans-6-styryl-2-nitrophenol (200 mg, 0.83 mmol) and tin (II) chloride (560 mg, 2.60 mmol) in ethanol (50 mL) was heated at 80°C under argon. After 2 hours, the starting material has disappeared and the solution was allowed to cool down and then poured into ice. The pH is made slightly basic (pH 7-8), by addition of solid NaOH, before being

20 extracted with ethyl acetate. The organic phase was washed with brine, dried over MgSO<sub>4</sub> and filtered. The solvent was evaporated and chromatography of the resulting solid on silica gel (4% MeOH/ CH<sub>2</sub>Cl<sub>2</sub>) gave the desired product (50 mg, 29 %). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 7.51 (m, 3H), 7.29 (m, 3H), 7.11 (t, 1H), 7.00 (m, 2H), 6.69 (m, 2H).

##### c) Preparation of N-[trans-3-styryl-2-hydroxyphenyl]-N'-[2-bromophenyl] urea

25 N-[trans-3-styryl-2-hydroxyphenyl]-N'-[2-bromophenyl] urea was prepared from trans-6-styryl-2-aminophenol (35 mg, 0.17 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane (1/20) and filtering. (36 mg, 53 %). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 7.97 (d, 1H), 7.62-7.48 (m, 4H), 7.45-7.26 (m, 5H), 7.25 (t, 1H), 7.15 (d, 1H), 7.01 (t, 1H), 6.88 (t, 2H).

30

### Example 120

#### Preparation of N-[2-hydroxy-3,4-dichlorophenyl]-N'-[2-methoxyphenyl] urea

N-[2-hydroxy-3,4-dichlorophenyl]-N'-[2-methoxyphenyl] urea was prepared from 2-amino-5,6-dichlorophenol (80 mg, 0.50 mmol, example 82b) according to the procedure in

35 General Method B. The product was purified by precipitation from methylene chloride/ hexane (1/20) and filtering. (125 mg, 77 %). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 8.02 (d, 1H), 7.79 (d, 1H), 7.05-6.86 (m, 4H), 3.92 (s, 3H).

Example 121Preparation of N-[2-hydroxy-3,4-dichlorophenyl]-N'-[4-methoxyphenyl] urea

5 N-[2-hydroxy-3,4-dichlorophenyl]-N'-[4-methoxyphenyl] urea was prepared from 2-amino-5,6-dichlorophenol (80mg, 0.50 mmol, example 82b) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/hexane(1equiv./20equiv.) and filtering. (120mg, 74%). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 7.89 (d, 1H), 7.35 (d, 2H), 6.99 (d, 1H), 6.90 (dd, 2H), 3.80 (s, 3H).

Example 122Preparation of N-[2-hydroxy-3,4-dichlorophenyl]-N'-[3-trifluoromethylphenyl] urea

10 N-[2-hydroxy-3,4-dichlorophenyl]-N'-[3-trifluoromethylphenyl] urea was prepared from 2-amino-5,6-dichlorophenol (80mg, 0.50 mmol, example 82b) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/hexane(1equiv./20equiv.) and filtering. (130mg, 71%). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 7.96 (d, 2H), 7.60 (d, 1H), 7.48 (t, 1H), 7.30 (d, 1H), 7.00 (d, 1H).

Example 123Preparation of N-[2-hydroxy-3,4-dichlorophenyl]-N'-[2-phenylphenyl] urea

20 N-[2-hydroxy-3,4-dichlorophenyl]-N'-[2-phenylphenyl] urea was prepared from 2-amino-5,6-dichlorophenol (80mg, 0.50 mmol, example 82b) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/hexane(1equiv./20equiv.) and filtering. (110mg, 59%). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 7.77 (d, 1H), 7.73 (d, 1H), 7.53-7.14 (m, 8H), 6.95 (d, 1H).

Example 124Preparation of N-[2-hydroxy-3,4-dichlorophenyl]-N'-[2,3-dichlorophenyl] urea

30 N-[2-Hydroxy-3,4-dichlorophenyl]-N'-[2,3-dichlorophenyl] urea was prepared from 2-amino-5,6-dichlorophenol (80mg, 0.50 mmol, example 82b) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/hexane(1equiv./20equiv.) and filtering. (130mg, 71%). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 8.06 (dd, 1H), 7.91 (d, 1H), 7.25 (m, 2H), 7.00 (d, 1H).

Example 125Preparation of N-[2-hydroxy-4-isopropylphenyl]-N'-[3-trifluoromethylphenyl] ureaa) Preparation of 2-nitro-5-isopropylphenol

3-isopropylphenol (3.00g, 22 mmol) was dissolved in methylene chloride(40ml) followed by the addition of sodium nitrate (2.06g, 24mmol). The addition of sulfuric acid



(25mL/ 3M) is then made, followed by addition of a catalytic amount of sodium nitrite. The mixture was allowed to stir. After 24 h, the reaction mixture is diluted with methylene chloride and extracted with water. The organic layer is dried over  $MgSO_4$  and filtered. The solvent was evaporated and chromatography of the resulting solid on silica gel (4% MeOH/  $CH_2Cl_2$ ) gave the desired product (1.09g, 27 %).  $^1H$  NMR ( $CD_3COCD_3$ ):  $\delta$  7.95 (d, 1H), 7.62 (d, 1H), 7.11 (d, 1H), 2.95 (m, 1H), 1.24 (d, 6H).

b) Preparation of 2-amino-5-isopropylphenol

To a solution of 2-nitro-5-isopropylphenol (1g, 6.4 mmol) in methanol (50 mL) was added 10% Pd/C (100 mg). The mixture was flushed with argon, then hydrogen was bubbled through the solution for 10 min, and a hydrogen atmosphere was maintained at balloon pressure overnight. The mixture was filtered through celite and the celite was washed with methanol. The solvent was evaporated and chromatography of the resulting solid on silica gel (5% MeOH/  $CH_2Cl_2$ ) gave the desired product (775 mg, 93 %).  $^1H$  NMR ( $CD_3OD$ ):  $\delta$  6.71-6.44 (m, 3H), 2.73 (m, 1H), 1.20 (d, 6H).

c) Preparation of N-[2-hydroxy-4-isopropylphenyl]-N'-[3-trifluoromethylphenyl] urea

N-[2-hydroxy-4-isopropylphenyl]-N'-[3-trifluoromethylphenyl] urea was prepared from 2-amino-5-isopropylphenol (75mg, 0.50 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/hexane (1equiv./20equiv.) and filtering. (140mg, 83%).  $^1H$  NMR ( $CD_3OD$ ):  $\delta$  7.91 (d, 2H), 7.62 (d, 1H), 7.47 (t, 1H), 7.39 (d, 1H), 6.75 (s, 1H), 6.72 (d, 1H), 2.80 (m, 1H), 1.21 (d, 6H).

Example 126

Preparation of N-[2-hydroxy-3-naphthyl]-N'-[2,3-dichlorophenyl] urea

N-[2-hydroxy-3-naphthyl]-N'-[2,3-dichlorophenyl] urea was prepared from 3-amino-2-naphthol (160mg, 1.00 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/hexane (1equiv./20equiv.) and filtering. (285mg, 82%).  $^1H$  NMR ( $CD_3OD$ ):  $\delta$  8.48 (s, 1H), 8.10 (d, 1H), 7.68 (d, 1H), 7.57 (d, 1H), 7.40-7.23 (m, 4H), 7.18 (d, 1H).

Example 127

Preparation of N-[2-[(2,3-Dichlorothiophen-5-yl)sulfonylamino]phenyl]-N'-(2-bromophenyl) urea

a) Preparation of [2-[(2,3-Dichlorothiophen-5-yl)sulfonylamino]aniline]

The title compound was prepared according to General Method C using 2,3-dichlorothiophene-5-sulfonyl chloride ((1 eq). The product was purified by flash chromatography on silica gel (ethyl acetate/hexane 20/80)-methylene chloride:methanol 90/10) (1.25 g, 39 %). EI-MS  $m/z$  321 (M-H)

- 80 -

b) Preparation of N-[2-[(2,3-Dichlorothien-5-yl)sulfonylamino]phenyl]-N'-(2-bromophenyl)urea

The title compound was prepared from [2-[(2,3-dichlorothien-5-yl)sulfonylamino]aniline (1.25 g, 3.9 mmol) and 2-(bromophenyl)isocyanate (768 mg, 3.9 mmol) according to General Method B. The product was purified by flash chromatography on silica gel (ethyl acetate:hexane 30/70) (272 mg, 13 %) EI-MS m/z 520 (M-H)

**Example 128**

Preparation of N-[2-[(3,5-Bis(trifluoromethyl)phenyl)sulfonylamino]phenyl]-N'-(2-bromophenyl)urea

a) Preparation of [2-(3,5-Bis(trifluoromethyl)phenyl)sulfonylamino]aniline

The title compound was prepared according to General Method C using 3,5-bis(trifluoromethyl)phenylsulfonyl chloride (1.28 g, 4.1 mmol) and o-phenylenediamine (441 mg, 4.1 mmol). The product was purified by flash chromatography on silica gel (methylene chloride:methanol 95/5) (611 mg, 39 %) EI-MS m/z 383 (M-H)

b) Preparation of N-[2-[(3,5-Bis(trifluoromethyl)phenyl)sulfonylamino]phenyl]-N'-(2-bromophenyl)urea

The title compound was prepared from [2-(3,5-bis(trifluoromethyl)phenyl)sulfonylamino]aniline (591 mg, 1.5 mmol) and 2-bromophenylisocyanate (305 mg, 1.5 mmol) according to General Method B. The product was purified by flash chromatography on silica gel (ethyl acetate:hexane 30/70) (10 mg, 1 %) EI-MS m/z 580 (M-H)

**Example 129**

Preparation of N-[2-[(2-Benzyl)sulfonylamino]-(5-trifluoromethyl)phenyl]-N'-(2-bromophenyl)urea

a) Preparation of [(4-Benzylsulfonylamino)-(3-nitro)-benzotrifluoride]

4-Amino-3-nitro-benzotrifluoride (1.0 g, 4.85 mmol) was mixed in DMF and the reaction mixture was cooled to 0°C. Sodium hydride (175 mg, 7.28 mmol) was added to the cold mixture and allowed to mix for ten minutes (a deep red color was noted). Toluenesulfonyl chloride (925 mg, 4.85 mmol) was added (reaction color changed to yellow) and the reaction was mixed for sixteen hours at room temperature. The reaction was quenched in NH<sub>4</sub>Cl and extracted with ethyl acetate:hexane (1:1). The product was purified by flash chromatography on silica gel (ethyl acetate:hexane 30/70) (878 mg, 52 %) EI-MS m/z 359 (M-H).

b) Preparation of [(4-Benzylsulfonylamino)-(3-amino)-benzotrifluoride]

[(4-Benzylsulfonylamino)-(3-nitro)-benzotrifluoride] (230 mg, 0.64 mmol) was mixed in methanol and poured into a Parr bottle. Palladium on carbon (15 mg) was added under an argon stream. The reaction mixture was placed on a Parr shaker (55 psi, H<sub>2</sub>) for several

hours. The reaction mixture was filtered through Celite to give the title compound. (210 mg, 99%) EI-MS  $m/z$  329 (M-H).

c) Preparation of N-[2-[(2-Benzyl)sulfonylamino]-(5-trifluoromethyl)phenyl]-N'-(2-bromophenyl)urea

- 5 The title compound was prepared from [(4-benzylsulfonylamino)-(3-amino)-benzotrifluoride (210 mg, 0.64 mmol) and 2-bromophenylisocyanate (126 mg, 0.64 mmol) according to the procedure in General Method B. The product was purified by flash chromatography on silica gel (ethyl acetate:hexane 30/70) (70 mg, 21%) EI-MS  $m/z$  526 (M-H)

10

### Example 130

#### Preparation of N-[2-[2-(3-Nitrophenyl)sulfonylamino]phenyl]-N'-(2-bromophenyl)urea

a) Preparation of [2-[(3-Nitrophenyl)sulfonylamino]aniline]

- 15 The title compound was prepared according to General Method C using 3-nitrobenzenesulfonyl chloride (1 eq). The product was purified by flash chromatography on silica gel (methylene chloride:methanol 96/4). (1.07 g, 37 %) EI-MS  $m/z$  294 (M+H)<sup>+</sup>

b) Preparation of N-[2-[(3-Nitrophenyl)sulfonylamino]phenyl]-N'-(2-bromophenyl)urea

- 20 The title compound was prepared from [2-(3-nitrophenyl)sulfonylaminoaniline] (590 mg, 2.0 mmol) and 2-(bromophenyl)isocyanate (398 mg, 2.0 mmol) according to the procedure in General Method B. The product was purified by flash chromatography on silica gel (ethyl acetate:hexane 30/70) (400 mg, 40%). EI-MS  $m/z$  489 (M-H)

### Example 131

- 25 Preparation of N-[2-[2-(4-Phenoxyphenyl)sulfonylamino]phenyl]-N'-(2-bromophenyl) urea

a) Preparation of [2-[(4-Phenoxyphenyl)sulfonylamino]aniline]

- 30 The title compound was prepared according to General Method C using 4-phenoxyphenylsulfonyl chloride (969 mg, 3.6 mmol) and o-phenylenediamine (300 mg, 2.77 mmol). The reaction mixture was partitioned between water (200 ml) and toluene:methylene chloride (1:3). The organic phase collected and the methylene chloride evaporated leaving the toluene. Hexane added and the product precipitated from solution. (317 mg, 34 %) EI-MS  $m/z$  341 (M+H)<sup>+</sup>

b) Preparation of N-[2-[(4-Phenoxyphenyl)sulfonylamino]phenyl]-N'-(2-bromophenyl)urea

- 35 The title compound was prepared from [2-(4-phenoxyphenyl)sulfonyl aminoaniline (276 mg, 0.8 mmol) and 2-(bromophenyl)isocyanate (161 mg, 0.8 mmol) according to the procedure in General Method B. The product was purified by flash chromatography on silica gel (ethyl acetate:hexane 30/70) (240 mg, 55 %) EI-MS  $m/z$  536 (M-H)

### Example 132

#### Preparation of N-[2-(1S)-10-Camphorsulfonylamino]phenyl]-N'-(2-bromophenyl)urea

##### a) Preparation of 2-((1S)-10-Camphorsulfonylamino)aniline

5        The title compound was prepared according to General Method C using (1S)(+)-10-Camphorsulfonyl chloride (1.16 g, 4.6 mmol) and o-phenylenediamine (500 mg, 4.6 mmol). The reaction mixture was partitioned between water (200 ml) and toluene:methylene chloride (1:3). The organic phase was separated and the methylene chloride evaporated leaving the toluene. Hexane was added and solid precipitated from solution. (130 mg, 9%) EI-MS m/z

10    323 (M+H)<sup>+</sup>

##### b) Preparation of N-[2-(1S)-10-Camphorsulfonylamino]phenyl]-N'-(2-bromophenyl)urea

      The title compound was prepared from [2-(1S)-10-camphorsulfonylamino]aniline (130 mg, 0.4 mmol) and 2-(bromophenyl)isocyanate (80 mg, 0.4 mmol) according to the procedure in General Method B. The solvent was evaporated and product was precipitated from

15    methylene chloride:hexane. (200 mg, 95 %). EI-MS m/z 518 (M-H)<sup>+</sup>

### Example 133

#### Preparation of N-[2-(1R)-10-Camphorsulfonylamino]phenyl]-N'-(2-bromophenyl)urea

##### a) Preparation of 2-((1R)-10-Camphorsulfonylamino)aniline

20        The title compound was prepared according to General Method C using (1R)(-)-10-camphorsulfonyl chloride (1.16 g, 4.6 mmol) and o-phenylenediamine (500 mg, 4.6 mmol). The reaction mixture was partitioned between water (200 mL) and toluene:methylene chloride(1:3). The organic phase was separated and the methylene chloride evaporated leaving the toluene. Hexane was added and the product precipitated from solution. (563 mg, 38%).

25    EI-MS m/z 323 (M+H)<sup>+</sup>

##### b) Preparation of N-[2-(1R)-10-Camphorsulfonylamino]phenyl]-N'-(2-bromophenyl)urea

      The title compound was prepared from [1-(1R)-10-camphorsulfonylaminoaniline] (563 mg, 1.75 mmol) and 2-(bromophenyl)isocyanate (346 mg, 1.75 mmol) according to the procedure in General Method B. The product was purified by flash chromatography on silica

30    gel (ethyl acetate:hexane 30/70) (263 mg, 29 %) EI-MS m/z 518 (M-H)<sup>+</sup>

### Example 134

#### Preparation of N-[2-[2-(2-Nitro-(4-trifluoromethyl)phenyl)sulfonylamino]phenyl]-N'-(2-bromophenyl)urea

##### a) Preparation of [2-[2-(2-Nitro-(4-trifluoromethyl)phenyl)sulfonylamino]aniline

35        The title compound was prepared according to General Method C using 2-nitro-4-(trifluoromethyl)benzenesulfonyl chloride (1 eq). The product was purified by flash chromatography on silica gel (methylene chloride:methanol 96/4) (875 mg, 25 %) EI-MS

m/z 362 (M+H)<sup>+</sup>

b) Preparation of N-[2-[2-(2-Nitro-(4-trifluoromethyl)phenyl)sulfonylamino]phenyl-N'-(2-bromophenyl)urea

The title compound was prepared from [2-[(2-nitro)-(4-trifluoromethyl)phenyl]sulfonylamino]aniline (740 mg, 2.1 mmol) and 2-(bromophenyl)isocyanate (406 mg, 2.1 mmol) according to General Method B. The product was purified by flash chromatography on silica gel (ethyl acetate:hexane 30/70). The product was further purified by recrystallization in ethyl acetate:hexane. (320 mg, 28 %) EI-MS m/z 557 (M-H)<sup>-</sup>

#### Example 135

10 Preparation of N-(2-hydroxy-4-azidophenyl)-N'-(2-iodophenyl)urea

a) Preparation of N-(2-hydroxy-4-aminophenyl)-N'-(2-iodophenyl)urea

To a solution of N-(2-hydroxy-4-nitrophenyl)-N'-(2-iodophenyl)urea (220 mg, 0.55 mmol) in ethanol (15 mL), Tin chloride (522 mg, 2.75 mmol) was added. The reaction mixture was stirred at reflux for 16 hours then cooled to room temperature. The reaction mixture was basified to pH 8 with aq. NaHCO<sub>3</sub> then extracted with ethyl acetate (3x). The organic extracts were combined, dried over MgSO<sub>4</sub>, filtered and concentrated under reduced pressure to give product (180 mg, 89%). EI-MS m/z 370 (M+H)<sup>+</sup>

b) Preparation of N-(2-hydroxy-4-azidophenyl)-N'-(2-iodophenyl)urea

The N-(2-hydroxy-4-aminophenyl)-N'-(2-iodophenyl)urea (77 mg, 0.21 mmol) was added to HCl/H<sub>2</sub>O (0.21 mL/0.42 mL), and cooled to 0°C. Sodium nitrate (14.5 mg, 0.21 mmol) was added to the reaction mixture. The reaction mixture was stirred at 0°C for 30 minutes. Sodium azide (14 mg, 0.21 mmol) was added to reaction mixture and it was warmed to room temperature. The reaction mixture was stirred at room temperature for 18 hours. Then it was extracted with three times by ethyl acetate. The organic extracts were combined, dried over MgSO<sub>4</sub>, filtered and concentrated under reduced pressure and chromatography of the resulting solid on silica gel (hexane : ethyl acetate: 5:1) gave product (20 mg, 24%). EI-MS m/z 396 (M+H)<sup>+</sup>.

#### Example 136

30 Preparation of N-(2-hydroxy-3-azidophenyl)-N'-(2-bromophenyl)urea

a) Preparation of N-(2-hydroxy-3-aminophenyl)-N'-(2-bromophenyl)urea

To a solution of N-(2-hydroxy-3-nitrophenyl)-N'-(2-bromophenyl)urea (300 mg, 0.85 mmol) in ethanol (20 mL), Tin chloride (958 mg, 4.25 mmol) was added. The reaction mixture was stirred at reflux for 16 hours then cooled to room temperature. The reaction mixture was basified to pH 8 with aq. NaHCO<sub>3</sub> then extracted with ethyl acetate (3x). The organic extracts were combined, dried over MgSO<sub>4</sub>, filtered and concentrated under reduced pressure to give product (274 mg, 99%). EI-MS m/z 323 (M+H)<sup>+</sup>.

## b) Preparation of N-(2-hydroxy-3-azidophenyl)-N'-(2-bromophenyl)urea

The N-(2-hydroxy-3-aminophenyl)-N'-(2-bromophenyl)urea (274 mg, 0.85 mmol) was added to HCl/H<sub>2</sub>O (0.85 mL/1.7 mL), cooled to 0°C. Sodium nitrate (58.6 mg, 0.85 mmol) was added to the reaction mixture. The reaction mixture was stirred at 0°C for 30 minutes.

- 5 Sodium azide (55 mg, 0.85 mmol) was added to reaction mixture and it was warmed to room temperature. The reaction mixture was stirred at room temperature for 18 hours then it was extracted with three times with ethyl acetate. The organic extracts were combined, dried over MgSO<sub>4</sub>, filtered and concentrated under reduced pressure and chromatography of the resulting solid on silica gel (hexane : ethyl acetate: 5:1) gave product (210 mg, 71%). EI-MS m/z 349 (M+H)<sup>+</sup>.

Example 137Preparation of N-[2-hydroxy-3-cyanophenyl]-N'-[2-methoxyphenyl] urea

- 15 N-[2-hydroxy-3-cyanophenyl]-N'-[2-methoxyphenyl] urea was prepared from 2-amino-6-cyanophenol (134mg, 1.00 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane(1equiv./20equiv.) and filtering. (230 mg, 81%). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 8.06 (d, 1H), 7.79 (d, 1H), 7.49-7.35 (m, 2H), 7.05-6.87 (m, 3H), 3.95 (s, 3H).

Example 138Preparation of N-[2-hydroxy-3-cyanophenyl]-N'-[3-trifluoromethylphenyl] urea

- 20 N-[2-hydroxy-3-cyanophenyl]-N'-[3-trifluoromethylphenyl] urea was prepared from 2-amino-6-cyanophenol (134mg, 1.00 mmol, example 83a) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane(1equiv./20equiv.) and filtering. (280mg, 87%). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 8.10 (d, 1H), 7.96 (s, 1H), 7.54 (d, 1H), 7.55-7.25 (m, 3H), 7.01 (t, 1H).

Example 139Preparation of N-[2-hydroxy-3-cyanophenyl]-N'-[2-phenylphenyl] urea

- 30 N-[2-hydroxy-3-cyanophenyl]-N'-[2-phenylphenyl] urea was prepared from 2-amino-6-cyanophenol (134mg, 1.00 mmol, example 83a) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane(1equiv./20equiv.) and filtering. (270mg, 82%). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 7.81 (d, 1H), 7.75 (d, 1H), 7.56-7.15 (m, 9H), 6.91 (t, 1H).

Example 140Preparation of N-[2-hydroxy-3-cyanophenyl]-N'-[2,3-dichlorophenyl] urea

- 85 -

N-[2-hydroxy-3-cyanophenyl]-N'-[2,3-dichlorophenyl] urea was prepared from 2-amino-6-cyanophenol (134mg, 1.00 mmol, example 83a) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/hexane (1equiv./20equiv.) and filtering. (300mg, 93%). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 8.11 (d, 1H), 8.01 (d, 1H), 7.33-7.25 (m, 3H), 7.00 (t, 1H).

#### Example 141

Preparation of N-[2-hydroxy-4-isopropylphenyl]-N'-[2,3-dichlorophenyl] urea N-[2-hydroxy-4-isopropylphenyl]-N'-[2,3-dichlorophenyl] urea was prepared from 2-amino-5-isopropylphenol (150 mg, 1.00 mmol, example 128a) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/hexane (1equiv./20equiv.) and filtering (285mg, 84%). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 8.05 (d, 2H), 7.77 (s, 1H), 7.26 (m, 2H), 6.88 (m, 2H), 2.82 (m, 1H), 1.25 (d, 6H).

#### Example 142

Preparation of N-[2-hydroxy-4-isopropylphenyl]-N'-[2-chloro-5-trifluoromethylphenyl] urea

N-[2-hydroxy-4-isopropylphenyl]-N'-[2-chloro-5-trifluoromethylphenyl] urea was prepared from 2-amino-5-isopropylphenol (150mg, 1.00 mmol, example 128a) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/hexane (1equiv./20equiv.) and filtering. (275mg, 82%). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 8.50 (s, 1H), 7.70 (s, 1H), 7.51 (d, 1H), 7.22 (d, 1H), 6.70 (m, 2H), 6.62 (dd, 1H), 2.76 (m, 1H), 1.16 (d, 6H).

#### Example 143

Preparation of N-[2-hydroxy-3-phenylphenyl]-N'-[2,3-dichlorophenyl] urea

a) Preparation of 2-nitro-6-phenylphenol

2-phenylphenol (3.00g, 17.6mmol) was dissolved in methylene chloride(40ml) followed by the addition of sodium nitrate (1.65g, 19.4mmol). The addition of sulfuric acid (25ml/ 3M) was then made, followed by addition of a catalytic amount of sodium nitrite. The mixture was allowed to stir. After 24 hrs, the reaction mixture was diluted with methylene chloride and extracted with water. The organic layer was dried over MgSO<sub>4</sub> and filtered. The solvent was evaporated and chromatography of the resulting solid on silica gel (4% MeOH/CH<sub>2</sub>Cl<sub>2</sub>) gave the desired product(900 mg, 24 %). <sup>1</sup>H NMR (CD<sub>3</sub>COCD<sub>3</sub>): δ 8.19 (d, 1H), 7.79 (d, 1H), 7.64 (d, 2H), 7.50 (t, 2H), 7.45 (t, 1H), 7.22 (t, 1H).

b) Preparation of 2-amino-6-phenylphenol

To a solution of 2-nitro-6-phenylphenol(900 mg, 4.2mmol) in methanol(50ml) was added 10% Pd/C (100 mg). The mixture was flushed with argon, then hydrogen was bubbled through the solution for 10 min. and a hydrogen atmosphere was maintained at balloon

- 86 -

pressure overnight. The mixture was filtered through celite and the celite was washed with methanol. The solvent was evaporated and chromatography of the resulting solid on silica gel (5% MeOH/ CH<sub>2</sub>Cl<sub>2</sub>) gave the desired product (700 mg, 90 %). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 7.55-7.27 (m, 5H), 6.77-6.61 (m, 3H)

5 c) Preparation of N-[2-hydroxy-3-phenylphenyl]-N'-[2,3-dichlorophenyl] urea

N-[2-hydroxy-3-phenylphenyl]-N'-[2,3-dichlorophenyl] urea was prepared from 2-amino-6-phenylphenol (92.5mg, 0.50 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane (1equiv./20equiv.) and filtering. (150mg, 81%). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 8.06 (d, 1H), 7.65 (d, 1H), 7.54 (d,

10 2H), 7.40 (t, 2H), 7.32 (d, 1H) 7.22 (m, 2H), 7.04-6.88

Preparation of N-[2-hydroxy-3-phenylphenyl]-N'-[2,3-dichlorophenyl] urea

b) N-[2-hydroxy-3-phenylphenyl]-N'-[2,3-dichlorophenyl] urea was prepared from 2-amino-6-phenylphenol (92.5mg, 0.50 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane (1equiv./20equiv.) and filtering. (150 mg, 81%). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 8.06 (d, 1H), 7.65 (d, 1H), 7.54 (d, 15 2H), 7.40 (t, 2H), 7.32 (d, 1H) 7.22 (m, 2H), 7.04-6.88 (m, 2H).

Example 144

Preparation of N-[2-hydroxy-5-nitrophenyl]-N'-[2-methoxyphenyl] urea

20 N-[2-hydroxy-5-nitrophenyl]-N'-[2-methoxyphenyl] urea was prepared from 2-amino-4-nitrophenol (154 mg, 1.00 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane (1equiv./20equiv.) and filtering. (270 mg, 89%). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 9.10 (s, 1H), 8.10 (d, 1H), 7.85 (d, 1H), 7.08-6.88 (m, 4H), 3.96 (s, 3H).

25

Example 145

Preparation of N-[2-hydroxy-5-nitrophenyl]-N'-[3-trifluoromethylphenyl] urea

N-[2-hydroxy-5-nitrophenyl]-N'-[3-trifluoromethylphenyl] urea was prepared from 2-amino-4-nitrophenol (154 mg, 1.00 mmol) according to the procedure in General Method B. 30 The product was purified by precipitation from methylene chloride/ hexane (1equiv./20equiv.) and filtering. (290 mg, 85%). <sup>1</sup>H NMR (CD<sub>3</sub>OD): δ 9.12 (s, 1H), 7.89 (d, 1H), 7.68 (d, 1H), 7.55 (m, 2H), 7.45 (d, 1H), 7.00 (d, 1H).

Example 146

35 Preparation of N-[2-hydroxy-5-nitrophenyl]-N'-[2-phenylphenyl] urea

N-[2-hydroxy-5-nitrophenyl]-N'-[2-phenylphenyl] urea was prepared from 2-amino-4-nitrophenol (154 mg, 1.00 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane (1equiv./20equiv.) and



filtering. (285 mg, 81%).  $^1\text{H}$  NMR ( $\text{CD}_3\text{OD}$ ):  $\delta$  8.09 (s, 1H), 7.86 (d, 1H), 7.58-7.20 (m, 9H), 6.95 (d, 1H).

#### Example 147

##### 5 Preparation of N-[2-hydroxy-5-nitrophenyl]-N'-[2,3-dichlorophenyl] urea

N-[2-hydroxy-5-nitrophenyl]-N'-[2,3-dichlorophenyl] urea was prepared from 2-amino-4-nitrophenol (154 mg, 1.00 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane(1equiv./20equiv.) and filtering. (290 mg, 85%).  $^1\text{H}$  NMR ( $\text{CD}_3\text{OD}$ ):  $\delta$  9.11 (s, 1H), 8.17 (d, 1H), 7.89 (d, 1H), 7.34 (m, 2H), 6.95 (d, 1H).

#### Example 148

##### Preparation of N-[2-hydroxy-5-ethylsulfonylphenyl]-N'-[2,3-dichlorophenyl] urea

15 N-[2-hydroxy-5-ethylsulfonylphenyl]-N'-[2,3-dichlorophenyl] urea was prepared from 2-amino-4-(ethylsulfonyl)phenol (185 mg, 1.00 mmol) according to the procedure in General Method B. The product was purified by precipitation from methylene chloride/ hexane(1equiv./20equiv.) and filtering. (310 mg, 84%).  $^1\text{H}$  NMR ( $\text{CD}_3\text{OD}$ ):  $\delta$  8.65 (s, 1H), 8.18 (d, 1H), 7.45 (d, 1H), 7.26 (m, 2H), 7.00 (d, 1H), 3.33 (q, 2H), 1.24 (t, 3H).

20 The following compounds of Formula (I) may be prepared in accordance with the examples and schemes as described above:

Example 149 : N-[2-(2-Amino-(4-trifluoromethyl) phenyl) sulfonylamino] phenyl]- N'-(2-bromophenyl)urea EI-MS m/z 527 (M-H).

25 Example 150 : N-[2-(aminosulfonyl phenyl) 3-amino phenyl] N'-(2-bromo phenyl) ureaEI-MS m/z 426 (M+H).

The following compounds of Formula (I) may be prepared in accordance with the examples and schemes as described above, or may also be purchased commercially from well recognized sources. For instance, from Aldrich Chemical Company:

30 N-(2-Hydroxy-4-nitrophenyl)-N'-phenylurea

For instance, from the Alfred Bader Collection of Aldrich Chemical:

1-(2-Carboxyphenyl)-3-(3-fluorophenyl)urea

1-(2-Carboxyphenyl)-3-(3-chlorophenyl)urea

35

Available from Gallard Schlesinger Company and/or the Sigma Aldrich Library of Rare Compounds:

1-(2-Carboxyphenyl)-3-(4-chlorophenyl)urea

1-(p-Anisyl)-3-(2-carboxyphenyl)urea

Available from Gallard Schlisinger Company :

2-(3,4-Dichlorophenylcarbonyldiimino)-5-trifluoromethylbenzoic acid

5 2-(4-Chlorophenylcarbonyldiimino)-5-trifluoromethylbenzoic acid

N-Phenyl-N'-(2-carboxyphenyl)urea

From Maybridge Chemical Company, Cambridge England:

1,1'-(4-Methyl-2-phenylene)bis[3-tolyl]thiourea

10 N-(5-Chloro-2-hydroxy-4-nitrophenyl)-N'-phenylurea

The following compounds of Formula (I) may be prepared in accordance with the examples and schemes as described above, or as indicated by their respective citations in Chemical Abstracts:

15 1-(m-Anisyl)-3-(2-carboxyphenyl)urea;

1-(o-Anisyl)-3-(2-carboxyphenyl)urea ;

1-(2-Carboxyphenyl)-3-(3,4-dichlorophenyl)urea;

1-(2-Carboxyphenyl)-3-(2,4-dichlorophenyl)urea;

## 20 METHOD OF TREATMENT

The compounds of Formula (I), (Ia), (II) and (III), or a pharmaceutically acceptable salt thereof can be used in the manufacture of a medicament for the prophylactic or therapeutic treatment of any disease state in a human, or other mammal, which is exacerbated or caused by excessive or unregulated IL-8 cytokine production by such mammal's cell, such as but not  
25 limited to monocytes and/or macrophages, or other chemokines which bind to the IL-8  $\alpha$  or  $\beta$  receptor, also referred to as the type I or type II receptor.

For purposes herein, the compounds of Formula (I), (Ia), (Ib), (Ic), (II) and (III) all have the same dosages, and dosage formulations as that of Formula (I) are used interchangeably.

30 Accordingly, the present invention provides a method of treating a chemokine mediated disease, wherein the chemokine is one which binds to an IL-8  $\alpha$  or  $\beta$  receptor and which method comprises administering an effective amount of a compound of Formula (I) or a pharmaceutically acceptable salt thereof. In particular, the chemokines are IL-8, GRO $\alpha$ , GRO $\beta$ , GRO $\gamma$  or NAP-2.

35

The compounds of Formula (I) are administered in an amount sufficient to inhibit cytokine function, in particular IL-8, GRO $\alpha$ , GRO $\beta$ , GRO $\gamma$  or NAP-2, such that they are biologically regulated down to normal levels of physiological function, or in some case to

subnormal levels, so as to ameliorate the disease state. Abnormal levels of IL-8, GRO $\alpha$ , GRO $\beta$ , GRO $\gamma$  or NAP-2 for instance in the context of the present invention, constitute: (i) levels of free IL-8 greater than or equal to 1 picogram per mL; (ii) any cell associated IL-8, GRO $\alpha$ , GRO $\beta$ , GRO $\gamma$  or NAP-2 above normal physiological levels; or (iii) the presence of IL-8, GRO $\alpha$ , GRO $\beta$ , GRO $\gamma$  or NAP-2 above basal levels in cells or tissues in which IL-8, GRO $\alpha$ , GRO $\beta$ , GRO $\gamma$  or NAP-2 respectively, is produced.

There are many disease states in which excessive or unregulated IL-8 production is implicated in exacerbating and/or causing the disease. Chemokine mediated diseases include psoriasis, atopic dermatitis, arthritis, asthma, chronic obstructive pulmonary disease, adult respiratory distress syndrome, inflammatory bowel disease, Crohn's disease, ulcerative colitis, stroke, septic shock, endotoxic shock, gram negative sepsis, toxic shock syndrome, cardiac and renal reperfusion injury, glomerulonephritis, thrombosis, graft vs. host reaction, alzheimer's disease, allograft rejections, malaria, restinosis, angiogenesis or undesired hematopoietic stem cells release.

These diseases are primarily characterized by massive neutrophil infiltration, T-cell infiltration, or neovascular growth, and are associated with increased IL-8, GRO $\alpha$ , GRO $\beta$ , GRO $\gamma$  or NAP-2 production which is responsible for the chemotaxis of neutrophils into the inflammatory site or the directional growth of endothelial cells. In contrast to other inflammatory cytokines (IL-1, TNF, and IL-6), IL-8, GRO $\alpha$ , GRO $\beta$ , GRO $\gamma$  or NAP-2 has the unique property of promoting neutrophil chemotaxis, enzyme release including but not limited to elastase release as well as superoxide production and activation. The  $\alpha$ -chemokines but particularly, GRO $\alpha$ , GRO $\beta$ , GRO $\gamma$  or NAP-2, working through the IL-8 type I or II receptor can promote the neovascularization of tumors by promoting the directional growth of endothelial cells. Therefore, the inhibition of IL-8 induced chemotaxis or activation would lead to a direct reduction in the neutrophil infiltration.

The compounds of Formula (I) are administered in an amount sufficient to inhibit IL-8, binding to the IL-8 alpha or beta receptors, from binding to these receptors, such as evidenced by a reduction in neutrophil chemotaxis and activation. The discovery that the compounds of Formula (I) are inhibitors of IL-8 binding is based upon the effects of the compounds of Formulas (I) in the *in vitro* receptor binding assays which are described herein. The compounds of Formula (I) have been shown to be dual inhibitors of both recombinant type I and type II IL-8 receptors. Preferably the compounds are inhibitors of only one receptor, preferably Type II.

As used herein, the term "IL-8 mediated disease or disease state" refers to any and all disease states in which IL-8, GRO $\alpha$ , GRO $\beta$ , GRO $\gamma$  or NAP-2 plays a role, either by production of IL-8, GRO $\alpha$ , GRO $\beta$ , GRO $\gamma$  or NAP-2 themselves, or by IL-8, GRO $\alpha$ , GRO $\beta$ , GRO $\gamma$  or NAP-2 causing another monokine to be released, such as but not limited to IL-1, IL-6 or TNF. A disease state in which, for instance, IL-1 is a major component, and whose production or action, is exacerbated or secreted in response to IL-8, would therefore be considered a disease state mediated by IL-8.

As used herein, the term "chemokine mediated disease or disease state" refers to any and all disease states in which a chemokine which binds to an IL-8  $\alpha$  or  $\beta$  receptor plays a role, such as but not limited to IL-8, GRO- $\alpha$ , GRO- $\beta$ , GRO- $\gamma$ , or NAP-2. This would include a disease state in which, IL-8 plays a role, either by production of IL-8 itself, or by IL-8 causing another monokine to be released, such as but not limited to IL-1, IL-6 or TNF. A disease state in which, for instance, IL-1 is a major component, and whose production or action, is exacerbated or secreted in response to IL-8, would therefore be considered a disease state mediated by IL-8.

As used herein, the term "cytokine" refers to any secreted polypeptide that affects the functions of cells and is a molecule which modulates interactions between cells in the immune, inflammatory or hematopoietic response. A cytokine includes, but is not limited to, monokines and lymphokines, regardless of which cells produce them. For instance, a monokine is generally referred to as being produced and secreted by a mononuclear cell, such as a macrophage and/or monocyte. Many other cells however also produce monokines, such as natural killer cells, fibroblasts, basophils, neutrophils, endothelial cells, brain astrocytes, bone marrow stromal cells, epidermal keratinocytes and B-lymphocytes. Lymphokines are generally referred to as being produced by lymphocyte cells. Examples of cytokines include, but are not limited to, Interleukin-1 (IL-1), Interleukin-6 (IL-6), Interleukin-8 (IL-8), Tumor Necrosis Factor-alpha (TNF- $\alpha$ ) and Tumor Necrosis Factor beta (TNF- $\beta$ ).

As used herein, the term "chemokine" refers to any secreted polypeptide that affects the functions of cells and is a molecule which modulates interactions between cells in the immune, inflammatory or hematopoietic response, similar to the term "cytokine" above. A chemokine is primarily secreted through cell transmembranes and causes chemotaxis and activation of specific white blood cells and leukocytes, neutrophils, monocytes, macrophages, T-cells, B-cells, endothelial cells and smooth muscle cells. Examples of chemokines include, but are not limited to, IL-8, GRO- $\alpha$ , GRO- $\beta$ , GRO- $\gamma$ , NAP-2, IP-10, MIP-1 $\alpha$ , MIP- $\beta$ , PF4, and MCP 1, 2, and 3.

- 91 -

In order to use a compound of Formula (I) or a pharmaceutically acceptable salt thereof in therapy, it will normally be formulated into a pharmaceutical composition in accordance with standard pharmaceutical practice. This invention, therefore, also relates to a pharmaceutical composition comprising an effective, non-toxic amount of a compound of Formula (I) and a pharmaceutically acceptable carrier or diluent.

Compounds of Formula (I), pharmaceutically acceptable salts thereof and pharmaceutical compositions incorporating such may conveniently be administered by any of the routes conventionally used for drug administration, for instance, orally, topically, parenterally or by inhalation. The compounds of Formula (I) may be administered in conventional dosage forms prepared by combining a compound of Formula (I) with standard pharmaceutical carriers according to conventional procedures. The compounds of Formula (I) may also be administered in conventional dosages in combination with a known, second therapeutically active compound. These procedures may involve mixing, granulating and compressing or dissolving the ingredients as appropriate to the desired preparation. It will be appreciated that the form and character of the pharmaceutically acceptable carrier or diluent is dictated by the amount of active ingredient with which it is to be combined, the route of administration and other well-known variables. The carrier(s) must be "acceptable" in the sense of being compatible with the other ingredients of the formulation and not deleterious to the recipient thereof.

The pharmaceutical carrier employed may be, for example, either a solid or liquid. Exemplary of solid carriers are lactose, terra alba, sucrose, talc, gelatin, agar, pectin, acacia, magnesium stearate, stearic acid and the like. Exemplary of liquid carriers are syrup, peanut oil, olive oil, water and the like. Similarly, the carrier or diluent may include time delay material well known to the art, such as glyceryl mono-stearate or glyceryl distearate alone or with a wax.

A wide variety of pharmaceutical forms can be employed. Thus, if a solid carrier is used, the preparation can be tableted, placed in a hard gelatin capsule in powder or pellet form or in the form of a troche or lozenge. The amount of solid carrier will vary widely but preferably will be from about 25mg. to about 1g. When a liquid carrier is used, the preparation will be in the form of a syrup, emulsion, soft gelatin capsule, sterile injectable liquid such as an ampule or nonaqueous liquid suspension.

Compounds of Formula (I) may be administered topically, that is by non-systemic administration. This includes the application of a compound of Formula (I) externally to the epidermis or the buccal cavity and the insullation of such a compound into the ear, eye and

nose, such that the compound does not significantly enter the blood stream. In contrast, systemic administration refers to oral, intravenous, intraperitoneal and intramuscular administration.

- 5           Formulations suitable for topical administration include liquid or semi-liquid preparations suitable for penetration through the skin to the site of inflammation such as liniments, lotions, creams, ointments or pastes, and drops suitable for administration to the eye, ear or nose. The active ingredient may comprise, for topical administration, from 0.001% to 10% w/w, for instance from 1% to 2% by weight of the Formulation. It may however  
10       comprise as much as 10% w/w but preferably will comprise less than 5% w/w, more preferably from 0.1% to 1% w/w of the Formulation.

- Lotions according to the present invention include those suitable for application to the skin or eye. An eye lotion may comprise a sterile aqueous solution optionally containing a  
15       bactericide and may be prepared by methods similar to those for the preparation of drops. Lotions or liniments for application to the skin may also include an agent to hasten drying and to cool the skin, such as an alcohol or acetone, and/or a moisturizer such as glycerol or an oil such as castor oil or arachis oil.

- 20           Creams, ointments or pastes according to the present invention are semi-solid formulations of the active ingredient for external application. They may be made by mixing the active ingredient in finely-divided or powdered form, alone or in solution or suspension in an aqueous or non-aqueous fluid, with the aid of suitable machinery, with a greasy or non-greasy base. The base may comprise hydrocarbons such as hard, soft or liquid paraffin, glycerol,  
25       beeswax, a metallic soap, a mucilage, an oil of natural origin such as almond, corn, arachis, castor or olive oil; wool fat or its derivatives or a fatty acid such as steric or oleic acid together with an alcohol such as propylene glycol or a macrogel. The formulation may incorporate any suitable surface active agent such as an anionic, cationic or non-ionic surfactant such as a sorbitan ester or a polyoxyethylene derivative thereof. Suspending agents such as natural  
30       gums, cellulose derivatives or inorganic materials such as siliceous silicas, and other ingredients such as lanolin, may also be included.

- Drops according to the present invention may comprise sterile aqueous or oily solutions or suspensions and may be prepared by dissolving the active ingredient in a suitable aqueous  
35       solution of a bactericidal and/or fungicidal agent and/or any other suitable preservative, and preferably including a surface active agent. The resulting solution may then be clarified by filtration, transferred to a suitable container which is then sealed and sterilized by autoclaving or maintaining at 98-100°C. for half an hour. Alternatively, the solution may be sterilized by

filtration and transferred to the container by an aseptic technique. Examples of bactericidal and fungicidal agents suitable for inclusion in the drops are phenylmercuric nitrate or acetate (0.002%), benzalkonium chloride (0.01%) and chlorhexidine acetate (0.01%). Suitable solvents for the preparation of an oily solution include glycerol, diluted alcohol and propylene glycol.

Compounds of formula (I) may be administered parenterally, that is by intravenous, intramuscular, subcutaneous intranasal, intrarectal, intravaginal or intraperitoneal administration. The subcutaneous and intramuscular forms of parenteral administration are generally preferred. Appropriate dosage forms for such administration may be prepared by conventional techniques. Compounds of Formula (I) may also be administered by inhalation, that is by intranasal and oral inhalation administration. Appropriate dosage forms for such administration, such as an aerosol formulation or a metered dose inhaler, may be prepared by conventional techniques.

For all methods of use disclosed herein for the compounds of Formula (I), the daily oral dosage regimen will preferably be from about 0.01 to about 80 mg/kg of total body weight. The daily parenteral dosage regimen about 0.001 to about 80 mg/kg of total body weight. The daily topical dosage regimen will preferably be from 0.1 mg to 150 mg, administered one to four, preferably two or three times daily. The daily inhalation dosage regimen will preferably be from about 0.01 mg/kg to about 1 mg/kg per day. It will also be recognized by one of skill in the art that the optimal quantity and spacing of individual dosages of a compound of Formula (I) or a pharmaceutically acceptable salt thereof will be determined by the nature and extent of the condition being treated, the form, route and site of administration, and the particular patient being treated, and that such optimums can be determined by conventional techniques. It will also be appreciated by one of skill in the art that the optimal course of treatment, i.e., the number of doses of a compound of Formula (I) or a pharmaceutically acceptable salt thereof given per day for a defined number of days, can be ascertained by those skilled in the art using conventional course of treatment determination tests.

The invention will now be described by reference to the following biological examples which are merely illustrative and are not to be construed as a limitation of the scope of the present invention.

### BIOLOGICAL EXAMPLES

The IL-8, and Gro- $\alpha$  chemokine inhibitory effects of compounds of the present invention were determined by the following *in vitro* assay:

**Receptor Binding Assays:**

[<sup>125</sup>I] IL-8 (human recombinant) was obtained from Amersham Corp., Arlington Heights, IL, with specific activity 2000 Ci/mmol. Gro- $\alpha$  was obtained from NEN- New England Nuclear. All other chemicals were of analytical grade. High levels of recombinant human IL-8 type  $\alpha$  and  $\beta$  receptors were individually expressed in Chinese hamster ovary cells as described previously (Holmes, *et al.*, *Science*, 1991, 253, 1278). The Chinese hamster ovary membranes were homogenized according to a previously described protocol (Haour, *et al.*, *J Biol Chem.*, 249 pp 2195-2205 (1974)). Except that the homogenization buffer was changed to 10mM Tris-HCL, 1mM MgSO<sub>4</sub>, 0.5mM EDTA (ethylene-diaminetetra-acetic acid), 1mMPPMSF ( $\alpha$ -toluenesulphonyl fluoride), 0.5 mg/L Leupeptin, pH 7.5. Membrane protein concentration was determined using Pierce Co. micro-assay kit using bovine serum albumin as a standard. All assays were performed in a 96-well micro plate format. Each reaction mixture contained [<sup>125</sup>I] IL-8 (0.25 nM) or [<sup>125</sup>I] Gro- $\alpha$  and 0.5  $\mu$ g/mL of IL-8R $\alpha$  or 1.0  $\mu$ g/mL of IL-8R $\beta$  membranes in 20 mM Bis-Trispropane and 0.4 mM Tris HCl buffers, pH 8.0, containing 1.2 mM MgSO<sub>4</sub>, 0.1 mM EDTA, 25 mM NaCl and 0.03% CHAPS. In addition, drug or compound of interest was added which had been pre-dissolved in DMSO so as to reach a final concentration of between 0.01nM and 100  $\mu$ M. The assay was initiated by addition of [<sup>125</sup>I]-IL-8. After 1 hour at room temperature the plate was harvested using a Tomtec 96-well harvester onto a glass fiber filtermat blocked with 1% polyethylenimine/0.5% BSA and washed 3 times with 25 mM NaCl, 10 mM TrisHCl, 1 mM MgSO<sub>4</sub>, 0.5 mM EDTA, 0.03 % CHAPS, pH 7.4. The filter was then dried and counted on the Betaplate liquid scintillation counter. The recombinant IL-8 R $\alpha$ , or Type I, receptor is also referred to herein as the non-permissive receptor and the recombinant IL-8 R $\beta$ , or Type II, receptor is referred to as the permissive receptor.

All of the exemplified compounds of Formulas (I) to (III) noted herein in the Synthetic Chemistry Section, of Examples 1 to 150 plus the additional purchased compounds demonstrated an IC<sub>50</sub> from about 45 to about <1  $\mu$ g/mL in the permissive models for IL-8 receptor inhibition. All of these compounds were also found to be inhibitors of Gro- $\alpha$  binding at about the same level. The compound 1-(2-Carboxyphenyl)-3-(4-chloro-2-methylphenyl)urea was found to be active at about 75  $\mu$ g/mL.

The following compounds, generally tested at levels of up to 45  $\mu$ g/mL were found to not demonstrate levels of IL-8 receptor antagonism within the criteria set forth above at the dosage levels tested. These compounds are:

1-(4-Chloro- $\alpha,\alpha,\alpha$ -trifluoro-3-tolyl)-3-[2-(4-chlorophenyl)thio]-5-chlorophenyl urea



- 1-(6-Chloro-alpha,alpha,alpha-trifluoro-3-tolyl)-3-[2-(4-chlorophenoxy)-5-chlorophenyl]urea
- 1-(2-Mercaptophenyl)-3-phenyl-2-thiourea
- 1-(2-Hydroxyphenyl)-3-phenyl-2-thiourea
- 5 3,3'-(Carbonothioyldiimino)bis[4-hydroxybenzoic acid]
- m,m'-(1,3-thioureylene)di(4-hydroxybenzoic acid)
- 1-(2-Tolyl)-3-(3-chloro-6-hydroxyphenyl)-2-thiourea
- 1-[(2-Hydroxy-4-aminophenyl)]-(3-phenyl)-urea
- N-(2-Carboxy-4-trifluoromethylphenyl)-N'-(3-chlorophenyl)urea
- 10 N-(2-Carboxyphenyl)-N'-(2,5-dichlorophenyl)urea
- 1-(2-Carboxyphenyl)-3-(2-Chloro-5-trifluoromethylphenyl)urea
- 2-[2-[3-(4-Bromophenyl)ureido]-4-trifluoromethylphenoxy]benzoic acid;
- 2-[2-[3-(4-Chlorophenyl)ureido]phenoxy]benzoic acid
- 2-[2-[3-(4-Chloro-3-(trifluoromethyl)phenyl)ureido]phenoxy]benzoic acid
- 15 N-(2-Hydroxyphenyl)-N'-phenyl urea
- N-[2-Hydroxy-5-(methoxycarbonyl)phenyl]-N'-phenylurea
- N-[4-Carboxy-2-hydroxyphenyl]-n'-phenylurea
- N-(2-Hydroxy-4-nitrophenyl)-N'-(4-nitrophenyl)urea;
- 1-(2-Carboxyphenyl)-3-(2,6-xylyl)urea
- 20 1-(6-Carboxy-2,4-dichlorophenyl)-3-(2,4,6-trichlorophenyl)urea
- 1-(2-Carboxyphenyl)-3-(2,5-dimethoxyphenyl)urea
- 1-(2-Carboxyphenyl)-3-(2-methylphenyl)urea
- 1-[(2-Hydroxyphenyl)-3-(2-methyl)-5-nitrophenyl]urea
- 1-(2,5-Dichlorophenyl)-3-(2-hydroxy-4-nitrophenyl)urea
- 25 1-(2-Carboxyphenyl)-3-(4-chloro-2-methylphenyl)urea
- N-(2-phenylsulfonylaminophenyl)-N'-phenylurea
- N-(2-Hydroxy-4-nitrophenyl)-N'-(4-ethoxycarbonylphenyl)urea
- N-(2-Hydroxy-4-nitrophenyl)-N'-(2-ethoxycarbonylphenyl)urea
- N-(2-Hydroxy-4-nitrophenyl)-N'-(3-ethoxycarbonylphenyl)urea
- 30 N-(2-Hydroxy-4-nitrophenyl)-N'-(4-phenylphenyl)urea
- N-(2-Hydroxy-4-nitrophenyl)-N'-(4-phenoxyphenyl)urea
- N-(2-Hydroxy-4-nitrophenyl)-N'-(4-propylphenyl)urea
- N-(4-Trifluoromethyl-2-(4-nitrobenzenesulfonyl)amino)-N'-phenylurea
- N-(3-Carboxyphenyl)-N'-2-hydroxy-4-nitrophenyl)urea
- 35 N-(4-Trifluoromethyl-2-(methylsulfonyl)amino)-N'-phenylurea
- N-(2-Hydroxy-4-nitrophenyl)-N'-[2-(isopropyl)phenyl]urea
- N-(2-Hydroxy-4-nitrophenyl)-N'-(2,6-dimethylphenyl)urea
- N-(2-Hydroxy-4-nitrophenyl)-N'-(2-fluoro-5-nitrophenyl)urea

- N-(2-Hydroxy-4-nitrophenyl)-N'-(2-chloro-5-trifluoromethylphenyl)urea  
N-(2-Hydroxy-4-nitrophenyl)-N'-(2-methoxy-4-nitrophenyl)urea  
N-(2-Hydroxy-1-naphthyl)-N'-(2-phenylphenyl)urea  
N-(2-Hydroxy-5-ethylsulfonylphenyl)-N'-(2-bromophenyl)urea  
5 N-(2-hydroxy 3,4 dichlorophenyl)-N'-(4-phenylphenyl)urea  
N-(2-hydroxy-3-naphthyl)-N'-(2-methoxyphenyl)urea  
N-(2-hydroxy-3-naphthyl)-N'-(2-phenylphenyl)urea  
N-(2-Hydroxy-3-naphthyl)-N'-(4-methoxyphenyl)urea  
N-(2-Hydroxy-3-naphthyl)-N'-(3-trifluoromethylphenyl)urea  
10 N-(2-Hydroxy-3-naphthyl)-N'-(4-phenylphenyl)urea  
N-[2-(2-Carboxyphenylsulfonylamino)phenyl]-N'-(2-bromophenyl)urea  
N-(2-Hydroxy-3-phenylphenyl)-N'-(2-methoxyphenyl)urea  
N-(2-Hydroxy-3-phenylphenyl)-N'-(4-methoxyphenyl)urea  
N-(2-Hydroxy-3-phenylphenyl)-N'-(3-trifluoromethylphenyl)urea  
15 N-(2-Hydroxy-3-phenylphenyl)-N'-(2-phenylphenyl)urea  
N-(2-Hydroxy-3-phenylphenyl)-N'-(4-phenylphenyl)urea  
N-[2-[(2,5-Dichlorothien-3-yl)sulfonylamino]phenyl]-N'-(2-bromophenyl)urea  
N-(2-Hydroxy-3,4-dichlorophenyl)-N'-(2,4 dimethoxyphenyl)urea  
N-(2-Hydroxy-3,4-dichlorophenyl)-N'-(2-chloro-5-trifluoromethylphenyl)urea  
20 N-(2-Hydroxy-3-naphthyl)-N'-(2,4 dimethoxyphenyl)urea  
N-(2-Hydroxy-3-naphthyl)-N'-(2-chloro-5-trifluoromethylphenyl)urea  
N-(2-Hydroxy-3-phenylphenyl)-N'-(2,4-dimethoxyphenyl)urea  
N-(2-Hydroxy-4-isopropylphenyl)-N'-(2,4-dimethoxyphenyl)urea  
N-(2-Hydroxy-3-phenylphenyl)-N'-(2-chloro-5-trifluoromethylphenyl)urea  
25 N-(2-Hydroxy-5-nitrophenyl)-N'-(2,4-dimethoxyphenyl)urea  
N-(2-Hydroxy-5-nitrophenyl)-N'-(2-chloro-5-trifluoromethylphenyl)urea  
N-(2-Hydroxy-3-cyanophenyl)-N'-(4-methoxyphenyl)urea  
N-(2-Hydroxy-3-cyanophenyl)-N'-(4-phenylphenyl)urea  
N-(2-Hydroxy-3-cyanophenyl)-N'-(2,4 dimethoxyphenyl)urea  
30 N-(2-Hydroxy-3-cyanophenyl)-N'-(2-chloro-5-trifluoromethylphenyl)urea  
N-(2-Hydroxy-5-phenylphenyl)-N'-(2-methoxyphenyl)urea  
N-(2-Hydroxy-5-phenylphenyl)-N'-(4-methoxyphenyl)urea  
N-(2-Hydroxy-5-phenylphenyl)-N'-(3-trifluoromethylphenyl)urea  
N-(2-Hydroxy-5-phenylphenyl)-N'-(2-phenylphenyl)urea  
35 N-(2-Hydroxy-5-phenylphenyl)-N'-(4-phenylphenyl)urea  
N-(2-Hydroxy-5-phenylphenyl)-N'-(2,3-dichlorophenyl)urea  
N-(2-Hydroxy-5-phenylphenyl)-N'-(2,4-dimethoxyphenyl)urea  
N-(2-Hydroxy-5-phenylphenyl)-N'-(2-chloro-5-trifluoromethylphenyl)urea

- N-(2-Hydroxy-5-ethylsulfonylphenyl)-N'-(4-methoxyphenyl)urea  
 N-(2-Hydroxy-5-ethylsulfonylphenyl)-N'-(3-trifluoromethylphenyl)urea  
 N-(2-Hydroxy-5-ethylsulfonylphenyl)-N'-(2-phenylphenyl)urea  
 N-(2-Hydroxy-5-ethylsulfonylphenyl)-N'-(4-phenylphenyl)urea  
 5 N-(2-Hydroxy-5-ethylsulfonylphenyl)-N'-(2,4-dimethoxyphenyl)urea  
 N-(2-Hydroxy-5-ethylsulfonylphenyl)-N'-(2-chloro-5-trifluoromethylphenyl)urea  
 N-[2-Hydroxy-3,4-dichlorophenyl]-N'-[2,4 dimethoxyphenyl] urea  
 N-[2-Hydroxy-3,4-dichlorophenyl]-N'-[2-chloro-5-trifluoromethylphenyl] urea  
 10 N-[2-Hydroxy-3-naphthyl]-N'-[3-trifluoromethylphenyl] urea

#### Chemotaxis Assay :

The *in vitro* inhibitory properties of these compounds were determined in the neutrophil chemotaxis assay as described in Current Protocols in Immunology, vol I, Suppl 1, Unit 6.12.3., whose disclosure is incorporated herein by reference in its entirety.

- 15 Neutrophils were isolated from human blood as described in Current Protocols in Immunology Vol I, Suppl 1 Unit 7.23.1, whose disclosure is incorporated herein by reference in its entirety. The chemoattractants IL-8, GRO- $\alpha$ , GRO- $\beta$ , GRO- $\gamma$  and NAP-2 were placed in the bottom chamber of a 48 multiwell chamber (Neuro Probe, Cabin John, MD) at a concentration between 0.1 and 100 nM. The two chambers were separated by a  
 20 Sum polycarbonate filter. When compounds of this invention were tested, they were mixed with the cells (0.001 - 1000 nM) just prior to the addition of the cells to the upper chamber. Incubation was allowed to proceed for between about 45 and 90 min at about 37°C in a humidified incubator with 5% CO<sub>2</sub>. At the end of the incubation period, the polycarbonate membrane was removed and the top side washed, the membrane was then stained using the  
 25 Diff Quick staining protocol (Baxter Products, McGaw Park, IL, USA). Cells which had chemotaxed to the chemokine were visually counted using a microscope. Generally, four fields were counted for each sample, these numbers were averaged to give the average number of cells which had migrated. Each sample was tested in triplicate and each compound repeated at least four times. To certain cells (positive control cells) no compound was added.  
 30 these cells represent the maximum chemotactic response of the cells. In the case where a negative control (unstimulated) was desired, no chemokine was added to the bottom chamber. The difference between the positive control and the negative control represents the chemotactic activity of the cells.

#### 35 Elastase Release Assay:

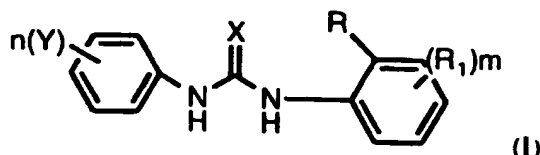
The compounds of this invention were tested for their ability to prevent Elastase release from human neutrophils. Neutrophils were isolated from human blood as described in Current Protocols in Immunology Vol I, Suppl 1 Unit 7.23.1. PMNs  $0.88 \times 10^6$  cells

- 98 -

- suspended in Ringer's Solution (NaCl 118, KCl 4.56, NaHCO<sub>3</sub> 25, KH<sub>2</sub>PO<sub>4</sub> 1.03, Glucose 11.1, HEPES 5 mM, pH 7.4) where placed in each well of a 96 well plate in a volume of 50 ul. To this plate was added the test compound (0.001 - 1000 nM) in a volume of 50 ul, Cytochalasin B in a volume of 50 ul (20ug/ml) and Ringers buffer in a volume of 50 ul.
- 5 These cells were allowed to warm (37 °C, 5% CO<sub>2</sub>, 95% RH) for 5 min before IL-8, GRO $\alpha$ , GRO $\beta$ , GRO $\gamma$  or NAP-2 at a final concentration of 0.01 - 1000 nM was added. The reaction was allowed to proceed for 45 min before the 96 well plate was centrifuged (800 xg 5 min) and 100 ul of the supernatant removed. This supernatant was added to a second 96 well plate followed by an artificial elastase substrate (MeOSuc-Ala-Ala-Pro-Val-AMC, Nova
- 10 Biochem, La Jolla, CA) to a final concentration of 6 ug/ml dissolved in phosphate buffered saline. Immediately, the plate was placed in a fluorescent 96 well plate reader (Cytofluor 2350, Millipore, Bedford, MA) and data collected at 3 min intervals according to the method of Nakajima et al J. Biol Chem 254 4027 (1979). The amount of Elastase released from the PMNs was calculated by measuring the rate of MeOSuc-Ala-Ala-Pro-Val-AMC degradation.
- 15

- The above description fully discloses the invention including preferred embodiments thereof. Modifications and improvements of the embodiments specifically disclosed herein are within the scope of the following claims. Without further elaboration, it is believed that one skilled in the art can, using the preceding description, utilize the present invention to its fullest
- 20 extent. Therefore the Examples herein are to be construed as merely illustrative and not a limitation of the scope of the present invention in any way. The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows.

1. A method of treating a chemokine mediated disease state, wherein the chemokine binds to an IL-8  $\alpha$  or  $\beta$  receptor in a mammal, which comprises administering to said mammal an effective amount of a compound of the formula:



wherein

X is oxygen or sulfur;

R is any functional moiety having an ionizable hydrogen and a pKa of 10 or less;

10 R<sub>1</sub> is independently selected from hydrogen; halogen; nitro; cyano; halosubstituted C<sub>1-10</sub> alkyl; C<sub>1-10</sub> alkyl; C<sub>2-10</sub> alkenyl; C<sub>1-10</sub> alkoxy; halosubstituted C<sub>1-10</sub> alkoxy; azide; S(O)<sub>1</sub>R<sub>4</sub>; hydroxy; hydroxy C<sub>1-4</sub>alkyl; aryl; aryl C<sub>1-4</sub> alkyl; aryloxy; aryl C<sub>1-4</sub> alkyloxy; heteroaryl; heteroarylalkyl; heterocyclic, heterocyclic C<sub>1-4</sub>alkyl; heteroaryl C<sub>1-4</sub> alkyloxy; aryl C<sub>2-10</sub> alkenyl; heteroaryl C<sub>2-10</sub> alkenyl; heterocyclic C<sub>2-10</sub> alkenyl; NR<sub>4</sub>R<sub>5</sub>; C<sub>2-10</sub> alkenyl C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>10</sub>; S(O)<sub>3</sub>H; S(O)<sub>3</sub>R<sub>8</sub>; C<sub>1-10</sub> alkyl C(O)R<sub>11</sub>; C<sub>2-10</sub> alkenyl C(O)R<sub>11</sub>; C<sub>2-10</sub> alkenyl C(O)OR<sub>11</sub>; C(O)R<sub>11</sub>; C(O)OR<sub>12</sub>; OC(O)R<sub>11</sub>; NR<sub>4</sub>C(O)R<sub>11</sub>; or two R<sub>1</sub> moieties together may form O-(CH<sub>2</sub>)<sub>5</sub>O- or a 5 to 6 membered unsaturated ring;

t is 0, or an integer having a value of 1 or 2;

20 s is an integer having a value of 1 to 3;

R<sub>4</sub> and R<sub>5</sub> are independently hydrogen, optionally substituted C<sub>1-4</sub> alkyl, optionally substituted aryl, optionally substituted aryl C<sub>1-4</sub>alkyl, optionally substituted heteroaryl, optionally substituted heteroaryl C<sub>1-4</sub>alkyl, heterocyclic, heterocyclic C<sub>1-4</sub> alkyl, or R<sub>4</sub> and R<sub>5</sub> together with the nitrogen to which they are attached form a 5 to 7 member ring which may optionally comprise an additional heteroatom selected from O/N/S;

25 Y is independently selected from hydrogen; halogen; nitro; cyano; halosubstituted C<sub>1-10</sub> alkyl; C<sub>1-10</sub> alkyl; C<sub>2-10</sub> alkenyl; C<sub>1-10</sub> alkoxy; halosubstituted C<sub>1-10</sub> alkoxy; azide; S(O)<sub>1</sub>R<sub>4</sub>; hydroxy; hydroxy C<sub>1-4</sub>alkyl; aryl; aryl C<sub>1-4</sub> alkyl; aryloxy; aryl C<sub>1-4</sub> alkyloxy; heteroaryl; heteroarylalkyl; heteroaryl C<sub>1-4</sub> alkyloxy; heterocyclic, heterocyclic C<sub>1-4</sub>alkyl; aryl C<sub>2-10</sub> alkenyl; heteroaryl C<sub>2-10</sub> alkenyl; heterocyclic C<sub>2-10</sub> alkenyl; NR<sub>4</sub>R<sub>5</sub>; C<sub>2-10</sub> alkenyl C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>10</sub>; S(O)<sub>3</sub>H; S(O)<sub>3</sub>R<sub>8</sub>; C<sub>1-10</sub> alkyl C(O)R<sub>11</sub>; C<sub>2-10</sub> alkenyl C(O)R<sub>11</sub>; C<sub>2-10</sub> alkenyl C(O)OR<sub>11</sub>; C(O)R<sub>11</sub>; C(O)OR<sub>12</sub>; OC(O)R<sub>11</sub>; NR<sub>4</sub>C(O)R<sub>11</sub>; or two Y moieties together may form O-(CH<sub>2</sub>)<sub>5</sub>O- or a 5 to 6 membered unsaturated ring;

35 n is an integer having a value of 1 to 3;

- 100 -

m is an integer having a value of 1 to 3;

R<sub>8</sub> is hydrogen or C<sub>1-4</sub> alkyl;

R<sub>10</sub> is C<sub>1-10</sub> alkyl C(O)<sub>2</sub>R<sub>8</sub>;

R<sub>11</sub> is hydrogen, C<sub>1-4</sub> alkyl, optionally substituted aryl, optionally substituted aryl C<sub>1-4</sub>alkyl,  
 5 optionally substituted heteroaryl, optionally substituted heteroaryl C<sub>1-4</sub>alkyl, optionally substituted heterocyclic, or optionally substituted heterocyclic C<sub>1-4</sub>alkyl;

R<sub>12</sub> is hydrogen, C<sub>1-10</sub> alkyl, optionally substituted aryl or optionally substituted arylalkyl; or a pharmaceutically acceptable salt thereof.

10 2. The method according to Claim 1 wherein the ionizable hydrogen has a pK<sub>a</sub> of 3 to 10.

3. The method according to Claim 2 wherein R is hydroxy, carboxylic acid, thiol, -SR<sub>2</sub>, -OR<sub>2</sub>, -NH-C(O)R<sub>a</sub>, -C(O)NR<sub>6</sub>R<sub>7</sub>, -NHS(O)<sub>2</sub>R<sub>b</sub>, -S(O)<sub>2</sub>NHR<sub>c</sub>, NHC(X)NHR<sub>b</sub>, or tetrazolyl;

15 wherein R<sub>2</sub> is a substituted aryl, heteroaryl, or heterocyclic moiety which ring has the functional moiety providing the ionizable hydrogen having a pK<sub>a</sub> of 10 or less;

R<sub>6</sub> and R<sub>7</sub> are independently hydrogen or a C<sub>1-4</sub> alkyl group, or R<sub>6</sub> and R<sub>7</sub> together with the nitrogen to which they are attached form a 5 to 7 member ring which ring may optionally contain an additional heteroatom which heteroatom is selected from oxygen, nitrogen  
 20 or sulfur;

R<sub>a</sub> is an alkyl, aryl, aryl C<sub>1-4</sub>alkyl, heteroaryl, heteroaryl C<sub>1-4</sub>alkyl, heterocyclic, or a heterocyclic C<sub>1-4</sub>alkyl moiety, all of which may be optionally substituted;

R<sub>b</sub> is a NR<sub>6</sub>R<sub>7</sub>, alkyl, aryl, arylC<sub>1-4</sub>alkyl, arylC<sub>2-4</sub>alkenyl, heteroaryl, heteroarylC<sub>1-4</sub>alkyl, heteroarylC<sub>2-4</sub>alkenyl, heterocyclic, heterocyclic C<sub>1-4</sub>alkyl, heterocyclic C<sub>2-4</sub>alkenyl moiety, camphor, all of which may be optionally substituted one to three times  
 25 independently by halogen; nitro; halosubstituted C<sub>1-4</sub> alkyl; C<sub>1-4</sub> alkyl; C<sub>1-4</sub> alkoxy; NR<sub>9</sub>C(O)R<sub>a</sub>; C(O)NR<sub>6</sub>R<sub>7</sub>, S(O)<sub>3</sub>H, or C(O)OC<sub>1-4</sub> alkyl;

R<sub>9</sub> is hydrogen or a C<sub>1-4</sub> alkyl;

R<sub>c</sub> is alkyl, aryl, arylC<sub>1-4</sub>alkyl, arylC<sub>2-4</sub>alkenyl, heteroaryl, heteroarylC<sub>1-4</sub>alkyl, heteroarylC<sub>2-4</sub>alkenyl, heterocyclic, heterocyclic C<sub>1-4</sub>alkyl, or a heterocyclic C<sub>2-4</sub>alkenyl  
 30 moiety, all of which may be optionally substituted one to three times independently by halogen, nitro, halosubstituted C<sub>1-4</sub> alkyl, C<sub>1-4</sub> alkyl, C<sub>1-4</sub> alkoxy, NR<sub>9</sub>C(O)R<sub>a</sub>, C(O)NR<sub>6</sub>R<sub>7</sub>, S(O)<sub>3</sub>H, or C(O)OC<sub>1-4</sub> alkyl.

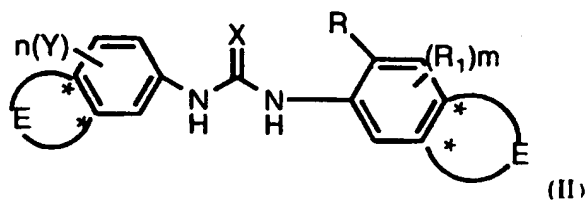
35 4. The method according to Claim 3 wherein the R<sub>2</sub> is optionally substituted one to three times by halogen, nitro, halosubstituted C<sub>1-10</sub> alkyl, C<sub>1-10</sub> alkyl, C<sub>1-10</sub> alkoxy, hydroxy, SH, -C(O)NR<sub>6</sub>R<sub>7</sub>, -NH-C(O)R<sub>a</sub>, -NHS(O)R<sub>b</sub>, S(O)NR<sub>6</sub>R<sub>7</sub>, C(O)OR<sub>8</sub>, or a tetrazolyl ring.

- 101 -

5. The method according to Claim 3 wherein R is OH, -NHS(O)<sub>2</sub>R<sub>h</sub> or C(O)OH.
6. The method according to Claim 1 wherein R<sub>1</sub> is halogen, cyano, nitro, CF<sub>3</sub>, C(O)NR<sub>4</sub>R<sub>5</sub>, alkenyl C(O)NR<sub>4</sub>R<sub>5</sub>, C(O)R<sub>4</sub>R<sub>10</sub>, alkenyl C(O)OR<sub>12</sub>, heteroaryl, heteroarylalkyl, heteroaryl alkenyl, or S(O)NR<sub>4</sub>R<sub>5</sub>.
7. The method according to Claim 1 wherein Y is halogen, C<sub>1-4</sub> alkoxy, optionally substituted aryl, optionally substituted arylalkoxy, methylene dioxy, NR<sub>4</sub>R<sub>5</sub>, thioC<sub>1-4</sub>alkyl, thioaryl, halosubstituted alkoxy, optionally substituted C<sub>1-4</sub>alkyl, hydroxy alkyl.
8. The method according to Claim 1 wherein R is OH, SH, or NHS(O)<sub>2</sub>R<sub>h</sub> and R<sub>1</sub> is substituted in the 3-position, the 4-position or disubstituted in the 3,4-position by an electron withdrawing moiety.
9. The compound according to Claims 1 or 8 wherein Y is mono-substituted in the 2'-position or 3'-position, or is disubstituted in the 2'- or 3'-position of a monocyclic ring.
10. The compound according to Claims 1, 8 or 9 wherein n and m are each equal to 1 or more.
11. The method according to Claim 1 wherein R is a carboxylic acid, and R<sub>1</sub> is hydrogen, or R<sub>1</sub> is substituted in the 4-position.
12. The method according to Claim 1 wherein the mammal is afflicted with a chemokine mediated disease selected from psoriasis, atopic dermatitis, asthma, chronic obstructive pulmonary disease, adult respiratory distress syndrome, arthritis, inflammatory bowel disease, Crohn's disease, ulcerative colitis, septic shock, endotoxic shock, gram negative sepsis, toxic shock syndrome, stroke, cardiac and renal reperfusion injury, glomerulo-nephritis, or thrombosis, alzheimers disease, graft vs. host reaction, or allograft rejections.
13. The method according to Claim 1 wherein the compound, or a pharmaceutically acceptable salt is:
- N-(2-Hydroxy-4-nitrophenyl)-N'-(2-methoxyphenyl)urea
- N-(2-Hydroxy-4-nitrophenyl)-N'-(2-bromophenyl)urea
- N-(2-Hydroxy-4-nitrophenyl)-N'-(2-phenylphenyl)urea
- N-(2-Hydroxy-4-nitrophenyl)-N'-(2-methylthiophenyl)urea
- N-(2-Hydroxy-4-nitrophenyl)-N'-(2,3-dichlorophenyl)urea
- N-(2-Hydroxy 4-nitro phenyl) N'-(2-chloro phenyl) urea

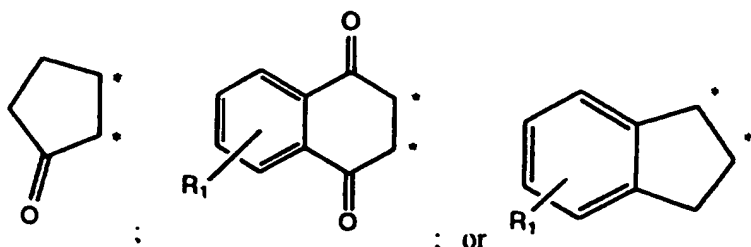
- N-(2-Hydroxy-4-nitrophenyl)-N'-(2,3-methylenedioxyphenyl)urea  
 N-(2-Hydroxy-4-nitrophenyl)-N'-(2-methoxy-3-chlorophenyl)urea  
 N-(2-hydroxy 4-nitro phenyl) N'-(2-phenyloxy phenyl) urea  
 N-(3-Chloro-2-hydroxyphenyl)-N'-(bromophenyl)urea  
 5 N-(2-Hydroxy-3-glycine methylester carbonyl phenyl)-N'-(2-bromophenyl)urea  
 N-(3-Nitro-2-hydroxyphenyl)-N'-(2-bromophenyl)urea  
 N-(2-Hydroxy-4-cyanophenyl)-N'-(2-bromophenyl)urea  
 N-(2-Hydroxy-3,4-dichlorophenyl)-N'-(2-bromophenyl)urea  
 N-(3-Cyano-2-hydroxyphenyl)-N'-(2-bromophenyl)urea  
 10 N-(2-Hydroxy-4-cyanophenyl)-N'-(2-methoxyphenyl)urea  
 N-(2-Hydroxy-4-cyanophenyl)-N'-(2-phenylphenyl)urea  
 N-(2-Hydroxy-4-cyanophenyl)-N'-(2,3-dichlorophenyl)urea  
 N-(2-Hydroxy-4-cyanophenyl)-N'-(2-methylphenyl)urea  
 N-(2-Hydroxy-3-cyano-4-methylphenyl)-N'-(2-bromophenyl)urea  
 15 N-(4-Cyano-2-hydroxyphenyl)-N'-(2-trifluoromethylphenyl)urea  
 N-(3-Trifluoromethyl-2-hydroxyphenyl)-N'-(2-bromophenyl)urea  
 N-(3-Phenylaminocarbonyl-2-hydroxyphenyl)-N'-(2-bromophenyl)urea  
 N-(2-hydroxy 4-nitro phenyl) N'-(2-iodo phenyl) urea  
 N-(2-hydroxy 4-nitro phenyl) N'-(2-bromo phenyl) thiourea  
 20 N-(2-phenylsulfonamido)-4-cyanophenyl-N'-(2-bromo phenyl)urea  
 (E)-N-[3-[(2-Aminocarbonyl)ethenyl]-2-hydroxyphenyl]-N'-(2-bromophenyl)urea  
 N-(2-Hydroxy-3,4-dichlorophenyl)-N'-(2-methoxyphenyl)urea  
 N-(2-Hydroxy-3,4-dichlorophenyl)-N'-(2-phenylphenyl)urea  
 N-(2-Hydroxy-3,4-dichlorophenyl)-N'-(2,3-dichlorophenyl)urea  
 25 N-(2-Hydroxy-5-nitrophenyl)-N'-(2,3-dichlorophenyl)urea; or  
 N-(2-Hydroxy-3-cyanophenyl)-N'-(2,3-dichlorophenyl)urea.

14. A compound of the formula:



30 E is optionally selected from

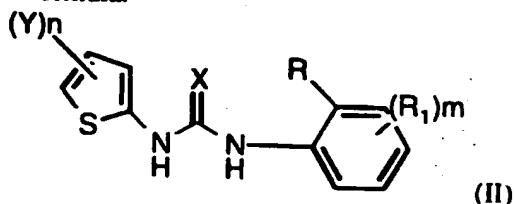




; or : the asterix \* denoting point of attachment of the ring; wherein at least one E ring is present; or a pharmaceutically acceptable salt thereof.

- 5 15. A pharmaceutical composition comprising a compound according to Claim 14 and a pharmaceutically acceptable carrier or diluent.
16. A method of treating a chemokine mediated disease state, wherein the chemokine binds to an IL-8  $\alpha$  or  $\beta$  receptor in a mammal, which comprises administering to said mammal an
- 10 effective amount of a compound of the formula according to Claim 14.

17. A compound of the formula:



wherein

- 15 X is oxygen or sulfur;
- R is any functional moiety having an ionizable hydrogen and a pKa of 10 or less;
- R<sub>1</sub> is independently selected from hydrogen; halogen; nitro; cyano; halosubstituted C<sub>1-10</sub> alkyl; C<sub>1-10</sub> alkyl; C<sub>2-10</sub> alkenyl; C<sub>1-10</sub> alkoxy; halosubstituted C<sub>1-10</sub> alkoxy; azide; S(O)<sub>t</sub>R<sub>4</sub>; hydroxy; hydroxyC<sub>1-4</sub>alkyl; aryl; aryl C<sub>1-4</sub> alkyl; aryloxy; arylC<sub>1-4</sub> alkyloxy;
- 20 heteroaryl; heteroarylalkyl; heterocyclic; heterocyclicC<sub>1-4</sub>alkyl; heteroarylC<sub>1-4</sub> alkyloxy; aryl C<sub>2-10</sub> alkenyl; heteroaryl C<sub>2-10</sub> alkenyl; heterocyclicC<sub>2-10</sub> alkenyl; NR<sub>4</sub>R<sub>5</sub>; C<sub>2-10</sub> alkenyl C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>10</sub>; S(O)<sub>3</sub>H; S(O)<sub>3</sub>R<sub>8</sub>; C<sub>1-10</sub> alkyl C(O)R<sub>11</sub>; C<sub>2-10</sub> alkenyl C(O)R<sub>11</sub>; C<sub>2-10</sub> alkenyl C(O)OR<sub>11</sub>; C(O)R<sub>11</sub>; C(O)OR<sub>12</sub>; OC(O) R<sub>11</sub>; NR<sub>4</sub>C(O)R<sub>11</sub>; or two R<sub>1</sub> moieties together may form O-(CH<sub>2</sub>)<sub>5</sub>O- or a 5 to 6
- 25 membered unsaturated ring;
- t is 0, or an integer having a value of 1 or 2;
- s is an integer having a value of 1 to 3;
- R<sub>4</sub> and R<sub>5</sub> are independently hydrogen, optionally substituted C<sub>1-4</sub> alkyl, optionally substituted aryl, optionally substituted aryl C<sub>1-4</sub>alkyl, optionally substituted heteroaryl,

- 104 -

optionally substituted heteroaryl C<sub>1-4</sub>alkyl, heterocyclic, heterocyclicC<sub>1-4</sub> alkyl, or R<sub>4</sub> and R<sub>5</sub> together with the nitrogen to which they are attached form a 5 to 7 member ring which may optionally comprise an additional heteroatom selected from O/N/S;

Y is independently selected from hydrogen; halogen; nitro; cyano; halosubstituted C<sub>1-10</sub> alkyl;

- 5 C<sub>1-10</sub> alkyl; C<sub>2-10</sub> alkenyl; C<sub>1-10</sub> alkoxy; halosubstituted C<sub>1-10</sub> alkoxy; azide; S(O)<sub>1</sub>R<sub>4</sub>; hydroxy; hydroxyC<sub>1-4</sub>alkyl; aryl; aryl C<sub>1-4</sub> alkyl; aryloxy; arylC<sub>1-4</sub> alkyloxy; heteroaryl; heteroarylalkyl; heteroarylC<sub>1-4</sub> alkyloxy; heterocyclic, heterocyclicC<sub>1-4</sub>alkyl; aryl C<sub>2-10</sub> alkenyl; heteroaryl C<sub>2-10</sub> alkenyl; heterocyclicC<sub>2-10</sub> alkenyl; NR<sub>4</sub>R<sub>5</sub>; C<sub>2-10</sub> alkenyl C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>10</sub>; S(O)<sub>3</sub>H; S(O)<sub>3</sub>R<sub>8</sub>; C<sub>1-10</sub> alkyl C(O)R<sub>11</sub>; C<sub>2-10</sub> alkenyl C(O)R<sub>11</sub>; C<sub>2-10</sub> alkenyl C(O)OR<sub>11</sub>; C(O)R<sub>11</sub>; C(O)OR<sub>12</sub>; OC(O) R<sub>11</sub>; NR<sub>4</sub>C(O)R<sub>11</sub>; or two Y moieties together may form O-(CH<sub>2</sub>)<sub>5</sub>O- or a 5 to 6 membered unsaturated ring;

n is an integer having a value of 1 to 3;

m is an integer having a value of 1 to 3;

- 15 R<sub>8</sub> is hydrogen or C<sub>1-4</sub> alkyl;

R<sub>10</sub> is C<sub>1-10</sub> alkyl C(O)<sub>2</sub>R<sub>8</sub>;

R<sub>11</sub> is hydrogen, C<sub>1-4</sub> alkyl, optionally substituted aryl, optionally substituted aryl C<sub>1-4</sub>alkyl, optionally substituted heteroaryl, optionally substituted heteroarylC<sub>1-4</sub>alkyl, optionally substituted heterocyclic, or optionally substituted heterocyclicC<sub>1-4</sub>alkyl;

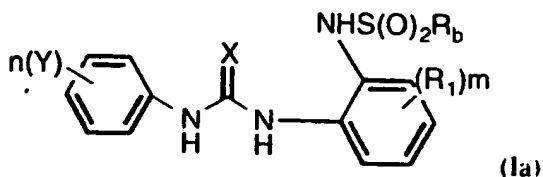
- 20 R<sub>12</sub> is hydrogen, C<sub>1-10</sub> alkyl, optionally substituted aryl or optionally substituted arylalkyl; or a pharmaceutically acceptable salt thereof.

18. A pharmaceutical composition comprising a compound according to Claim 17 and a pharmaceutically acceptable carrier or diluent.

25

19. A method of treating a chemokine mediated disease state, wherein the chemokine binds to an IL-8 α or β receptor in a mammal, which comprises administering to said mammal an effective amount of a compound of the formula according to Claim 17.

- 30 20. A compound of the formula:



wherein

X is oxygen or sulfur;

R<sub>a</sub> is an alkyl, aryl, arylC<sub>1-4</sub>alkyl, heteroaryl, heteroarylC<sub>1-4</sub>alkyl, heterocyclic, or a heterocyclic C<sub>1-4</sub>alkyl moiety, all of which may be optionally substituted;

R<sub>b</sub> is a NR<sub>6</sub>R<sub>7</sub>, alkyl, aryl, arylC<sub>1-4</sub>alkyl, arylC<sub>2-4</sub>alkenyl, heteroaryl, heteroarylC<sub>1-4</sub>alkyl, heteroarylC<sub>2-4</sub>alkenyl, heterocyclic, or heterocyclic C<sub>1-4</sub>alkyl, or a heterocyclic

C<sub>2-4</sub>alkenyl moiety, camphor, all of which may be optionally substituted one to three times independently by halogen; nitro; halosubstituted C<sub>1-4</sub> alkyl; C<sub>1-4</sub> alkyl; C<sub>1-4</sub> alkoxy;

NR<sub>9</sub>C(O)R<sub>a</sub>; C(O)NR<sub>6</sub>R<sub>7</sub>; S(O)<sub>3</sub>H, or C(O)OC<sub>1-4</sub> alkyl;

R<sub>6</sub> and R<sub>7</sub> are independently hydrogen or a C<sub>1-4</sub> alkyl group, or R<sub>6</sub> and R<sub>7</sub> together with the nitrogen to which they are attached form a 5 to 7 member ring which ring may optionally contain an additional heteroatom which heteroatom is selected from oxygen, nitrogen or sulfur, which ring may be optionally substituted;

R<sub>9</sub> is hydrogen or a C<sub>1-4</sub> alkyl;

R<sub>1</sub> is independently selected from hydrogen; halogen; nitro; cyano; halosubstituted C<sub>1-10</sub> alkyl; C<sub>1-10</sub> alkyl; C<sub>2-10</sub> alkenyl; C<sub>1-10</sub> alkoxy; halosubstituted C<sub>1-10</sub> alkoxy; azide;

S(O)<sub>t</sub>R<sub>4</sub>; hydroxy; hydroxyC<sub>1-4</sub>alkyl; aryl; aryl C<sub>1-4</sub> alkyl; aryloxy; arylC<sub>1-4</sub> alkyloxy; heteroaryl; heteroarylalkyl; heterocyclic, heterocyclicC<sub>1-4</sub>alkyl; heteroarylC<sub>1-4</sub> alkyloxy; aryl C<sub>2-10</sub> alkenyl; heteroaryl C<sub>2-10</sub> alkenyl; heterocyclicC<sub>2-10</sub> alkenyl; NR<sub>4</sub>R<sub>5</sub>; C<sub>2-10</sub> alkenyl C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>10</sub>; S(O)<sub>3</sub>H; S(O)<sub>3</sub>R<sub>8</sub>; C<sub>1-10</sub> alkyl

C(O)R<sub>11</sub>; C<sub>2-10</sub> alkenyl C(O)R<sub>11</sub>; C<sub>2-10</sub> alkenyl C(O)OR<sub>11</sub>; C(O)R<sub>11</sub>; C(O)OR<sub>12</sub>;

OC(O) R<sub>11</sub>; NR<sub>4</sub>C(O)R<sub>11</sub>; or two R<sub>1</sub> moieties together may form O-(CH<sub>2</sub>)<sub>5</sub>O- or a 5 to 6 membered unsaturated ring;

t is 0, or an integer having a value of 1 or 2;

s is an integer having a value of 1 to 3;

R<sub>4</sub> and R<sub>5</sub> are independently hydrogen, optionally substituted C<sub>1-4</sub> alkyl, optionally

substituted aryl, optionally substituted aryl C<sub>1-4</sub>alkyl, optionally substituted heteroaryl,

optionally substituted heteroaryl C<sub>1-4</sub>alkyl, heterocyclic, heterocyclicC<sub>1-4</sub> alkyl, or R<sub>4</sub> and

R<sub>5</sub> together with the nitrogen to which they are attached form a 5 to 7 member ring which

may optionally comprise an additional heteroatom selected from O/N/S;

Y is independently selected from hydrogen; halogen; nitro; cyano; halosubstituted C<sub>1-10</sub> alkyl;

C<sub>1-10</sub> alkyl; C<sub>2-10</sub> alkenyl; C<sub>1-10</sub> alkoxy; halosubstituted C<sub>1-10</sub> alkoxy; azide; S(O)<sub>t</sub>R<sub>4</sub>;

hydroxy; hydroxyC<sub>1-4</sub>alkyl; aryl; aryl C<sub>1-4</sub> alkyl; aryloxy; arylC<sub>1-4</sub> alkyloxy; heteroaryl;

heteroarylalkyl; heteroarylC<sub>1-4</sub> alkyloxy; heterocyclic, heterocyclicC<sub>1-4</sub>alkyl; aryl C<sub>2-10</sub> alkenyl; heteroaryl C<sub>2-10</sub> alkenyl; heterocyclic C<sub>2-10</sub> alkenyl; NR<sub>4</sub>R<sub>5</sub>; C<sub>2-10</sub> alkenyl

C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>10</sub>; S(O)<sub>3</sub>H; S(O)<sub>3</sub>R<sub>8</sub>; C<sub>1-10</sub> alkyl C(O)R<sub>11</sub>;

C<sub>2-10</sub> alkenyl C(O)R<sub>11</sub>; C<sub>2-10</sub> alkenyl C(O)OR<sub>11</sub>; C(O)R<sub>11</sub>; C(O)OR<sub>12</sub>; OC(O) R<sub>11</sub>;

NR<sub>4</sub>C(O)R<sub>11</sub>; or two Y moieties together may form O-(CH<sub>2</sub>)<sub>5</sub>O- or a 5 to 6 membered

unsaturated ring;

n is an integer having a value of 1 to 3;

m is an integer having a value of 1 to 3;

R<sub>8</sub> is hydrogen or C<sub>1-4</sub> alkyl;

R<sub>10</sub> is C<sub>1-10</sub> alkyl C(O)<sub>2</sub>R<sub>8</sub>;

R<sub>11</sub> is hydrogen, C<sub>1-4</sub> alkyl, optionally substituted aryl, optionally substituted aryl C<sub>1-4</sub>alkyl,  
 5 optionally substituted heteroaryl, optionally substituted heteroaryl C<sub>1-4</sub>alkyl, optionally substituted heterocyclic, or optionally substituted heterocyclic C<sub>1-4</sub>alkyl;

R<sub>12</sub> is hydrogen, C<sub>1-10</sub> alkyl, optionally substituted aryl or optionally substituted arylalkyl;  
 or a pharmaceutically acceptably salt thereof.

10 21. The compound according to Claim 20 wherein R<sub>1</sub> is substituted in the 3-position, the 4- position or di substituted in the 3,4- position by an electron withdrawing moiety.

22. The compound according to Claim 20 or 21 wherein Y is mono-substituted in the 2'- position or 3'- position, or is disubstituted in the 2'- or 3'- position of a monocyclic ring.

15

23. The compound according to Claim 20 or 21 wherein n and m are each equal to 1 or more.

24. The compound according to Claim 20 which is

20 N-(4-Nitro 2-(phenylsulfonylamino)phenyl)-N'-phenyl urea

N-[(2-Phenylsulfonylamido) 4-cyanophenyl]- N'-(2-bromo phenyl) urea

N-(2-(Amino sulfonylamido phenyl) phenyl) N'-(2-bromo phenyl) urea

N-(2-(Amino sulfonyl styryl) phenyl) N'-(2-bromo phenyl) urea

2-[(3,4 Di-methoxyphenylsulfonyl)amino] phenyl) N'-(2-bromo phenyl) urea

25 N-(2-[(4-Acetamidophenylsulfonyl)amino] phenyl) N'-(2-bromo phenyl) urea

N-(2-(Amino sulfonyl (2-thiophene) phenyl) N'-(2-bromo phenyl) urea

N-(2-(Amino sulfonyl (3-tolyl) phenyl) N'-(2-bromo phenyl) urea

N-(2-(Amino sulfonyl (8-quinoliny)) phenyl) N'-(2-bromo phenyl) urea

N-(2-(Amino sulfonyl benzyl) phenyl) N'-(2-bromo phenyl) urea

30 N-[2-[[2-(Trifluoromethyl)phenyl]sulfonyl]amino]phenyl]-N'-(2-bromophenyl)urea

N-(2-Bromophenyl)-N'-[2-dimethylaminosulfonylamino]phenyl]urea

N-[2-(Phenethylsulfonylamino)phenyl]-N'-(2-bromophenyl)urea

N-[2-[(2-Acetamido-4-methylthiazol-5-yl)sulfonylamino]phenyl]-N'-(2-bromophenyl)urea

N-[2-[(2,3-Dichlorothien-5-yl)sulfonylamino]phenyl]-N'-(2-bromophenyl)urea

35 N-[2-[(3,5-Bis(trifluoromethyl)phenyl)sulfonylamino]phenyl]-N'-(2-bromophenyl)urea

N-[2-[(2-Benzyl)sulfonylamino]-(5-trifluoromethyl)phenyl]-N'-(2-bromophenyl)urea

N-[2-[(2-(3-Nitrophenyl)sulfonylamino]phenyl]-N'-(2-bromophenyl)urea

N-[2-[(2-(4-Phenoxyphenyl)sulfonylamino]phenyl]-N'-(2-bromophenyl) urea

N-[[2-(1S)-10-Camphorsulfonylamino]phenyl]-N'-(2-bromophenyl)urea

N-[[2-(1R)-10-Camphorsulfonylamino]phenyl]-N'-(2-bromophenyl)urea

N-[2-[2-(2-Nitro-(4-trifluoromethyl)phenyl)sulfonylamino]phenyl-N'-(2-bromophenyl)urea

N-[2-(2-Amino-(4-trifluoromethyl)phenyl)sulfonylamino]phenyl]-N'-(2-

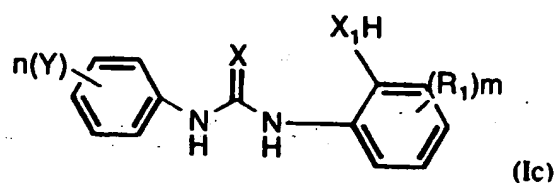
5 bromophenyl)urea ; or

N-[2-(aminosulfonyl phenyl) 3-amino phenyl] N'-(2-bromo phenyl) urea.

27. A pharmaceutical composition comprising a compound according to any of Claims 22  
to 27 and a pharmaceutically acceptable carrier or diluent.

10

28. A compound of the formula:



wherein

15 X is oxygen or sulfur;

X<sub>1</sub> is oxygen or sulfur;

R<sub>1</sub> is independently selected from hydrogen; halogen; nitro; cyano; halosubstituted C<sub>1-10</sub>

alkyl; C<sub>1-10</sub> alkyl; C<sub>2-10</sub> alkenyl; C<sub>1-10</sub> alkoxy; halosubstituted C<sub>1-10</sub> alkoxy; azide;

S(O)<sub>t</sub>R<sub>4</sub>; hydroxy; hydroxyC<sub>1-4</sub>alkyl; aryl; aryl C<sub>1-4</sub> alkyl; aryloxy; aryl C<sub>1-4</sub> alkyloxy;

20 heteroaryl; heteroarylalkyl; heterocyclic; heterocyclicC<sub>1-4</sub>alkyl; heteroarylC<sub>1-4</sub> alkyloxy;

aryl C<sub>2-10</sub> alkenyl; heteroaryl C<sub>2-10</sub> alkenyl; heterocyclic C<sub>2-10</sub> alkenyl; NR<sub>4</sub>R<sub>5</sub>; C<sub>2-10</sub>

alkenyl C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>10</sub>; S(O)<sub>3</sub>H; S(O)<sub>3</sub>R<sub>8</sub>; C<sub>1-10</sub> alkyl

C(O)R<sub>11</sub>; C<sub>2-10</sub> alkenyl C(O)R<sub>11</sub>; C<sub>2-10</sub> alkenyl C(O)OR<sub>11</sub>; C(O)R<sub>11</sub>; C(O)OR<sub>12</sub>;

OC(O)R<sub>11</sub>; NR<sub>4</sub>C(O)R<sub>11</sub>; or two R<sub>1</sub> moieties together may form O-(CH<sub>2</sub>)<sub>5</sub>O- or a 5 to 6

25 membered unsaturated ring;

t is 0, or an integer having a value of 1 or 2;

s is an integer having a value of 1 to 3;

R<sub>4</sub> and R<sub>5</sub> are independently hydrogen, optionally substituted C<sub>1-4</sub> alkyl, optionally

substituted aryl, optionally substituted aryl C<sub>1-4</sub>alkyl, optionally substituted heteroaryl,

30 optionally substituted heteroaryl C<sub>1-4</sub> alkyl, heterocyclic, heterocyclic C<sub>1-4</sub> alkyl, or R<sub>4</sub>

and R<sub>5</sub> together with the nitrogen to which they are attached form a 5 to 7 member ring

which may optionally comprise an additional heteroatom selected from O/N/S;

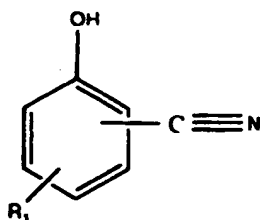
Y is independently selected from halogen; nitro; cyano; halosubstituted C<sub>1-10</sub> alkyl; C<sub>1-10</sub>

alkyl; C<sub>2-10</sub> alkenyl; C<sub>1-10</sub> alkoxy; halosubstituted C<sub>1-10</sub> alkoxy; azide; S(O)<sub>t</sub>R<sub>4</sub>;

35 hydroxy; hydroxy C<sub>1-4</sub>alkyl; aryl; aryl C<sub>1-4</sub> alkyl; aryloxy; arylC<sub>1-4</sub> alkyloxy; heteroaryl;

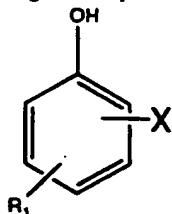
- heteroarylalkyl; heteroarylC<sub>1-4</sub> alkyloxy; heterocyclic, heterocyclic C<sub>1-4</sub>alkyl; aryl C<sub>2-10</sub> alkenyl; heteroaryl C<sub>2-10</sub> alkenyl; heterocyclic C<sub>2-10</sub> alkenyl; NR<sub>4</sub>R<sub>5</sub>; C<sub>2-10</sub> alkenyl C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>10</sub>; S(O)<sub>2</sub>H; S(O)<sub>2</sub>R<sub>8</sub>; C<sub>1-10</sub> alkyl C(O)R<sub>11</sub>; C<sub>2-10</sub> alkenyl C(O)R<sub>11</sub>; C<sub>2-10</sub> alkenyl C(O)OR<sub>11</sub>; C(O)R<sub>11</sub>; C(O)OR<sub>12</sub>; OC(O)R<sub>11</sub>; NR<sub>4</sub>C(O)R<sub>11</sub>; or two Y moieties together may form O-(CH<sub>2</sub>)<sub>5</sub>O- or a 5 to 6 membered unsaturated ring;
- n is an integer having a value of 1 to 2;
- m is an integer having a value of 1 to 3;
- R<sub>8</sub> is hydrogen or C<sub>1-4</sub> alkyl;
- 10 R<sub>10</sub> is C<sub>1-10</sub> alkyl C(O)<sub>2</sub>R<sub>8</sub>;
- R<sub>11</sub> is hydrogen, C<sub>1-4</sub> alkyl, optionally substituted aryl, optionally substituted aryl C<sub>1-4</sub>alkyl, optionally substituted heteroaryl, optionally substituted heteroaryl C<sub>1-4</sub>alkyl, optionally substituted heterocyclic, or optionally substituted heterocyclic C<sub>1-4</sub>alkyl;
- R<sub>12</sub> is hydrogen, C<sub>1-10</sub> alkyl, optionally substituted aryl or optionally substituted arylalkyl;
- 15 provided that:
- when n = 1 then Y is substituted in the 2'- or 3'- position;
- when n = 2 then Y is di-substituted in the 2'- 3'- position;
- further provided that
- when X<sub>1</sub> is S, m=1, R<sub>1</sub> is 4-ethyl, and n=1 then Y is not 2-methoxy;
- 20 or a pharmaceutically acceptable salt thereof.
27. The compound according to Claim 26 wherein R<sub>1</sub> is substituted in the 3-position, the 4- position or di-substituted in the 3,4- position by an electron withdrawing moiety.
- 25 28. The compound according to Claim 26 or 27 wherein Y is mono-substituted in the 2'- position or 3'- position, or is disubstituted in the 2' or 3' position of a monocyclic ring.
29. The compound according to Claim 26 or 27 wherein n and m are each equal to 1 or more.
- 30 30. A pharmaceutical composition comprising a compound according to any of Claims 26 to 29 and a pharmaceutically acceptable carrier or diluent.
31. A process for producing a cyano phenol derivative of the formula:

- 109 -



wherein R<sub>1</sub> is as defined for Formula (I) above, which method comprises

a) reacting a compound of the formula:



wherein X is halogen

- 5 with copper (I) cyanide, dimethylformamide, triethylamine and a catalytic amount of dimethylamino pyridine.

32. The process according to Claim 31 wherein the temperature is about 60 to about 80°C, and X is bromine.

## AMENDED CLAIMS

[received by the International Bureau on 16 July 1996 (16.07.96);  
original claims 1-32 replaced by amended claims 1-32 (3 pages)]

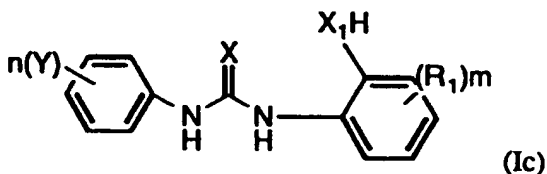
- N-(2-Bromophenyl)-N'-[2-dimethylaminosulfonylamino]phenyl]urea  
 N-[2-(Phenethylsulfonylamino)phenyl]-N'-(2-bromophenyl)urea  
 N-[2-[(2-Acetamido-4-methylthiazol-5-yl)sulfonylamino]phenyl]-N'-(2-bromophenyl)urea  
 N-[2-[(2,3-Dichlorothien-5-yl)]sulfonylamino]phenyl]-N'-(2-bromophenyl)urea  
 5 N-[2-[(3,5-Bistrifluoromethylphenyl)sulfonylamino]phenyl]-N'-(2-bromophenyl)urea  
 N-[2-[(2-Benzyl)sulfonylamino]-(5-trifluoromethyl)phenyl]-N'-(2-bromophenyl)urea  
 N-[2-[2-(3-Nitrophenyl)sulfonylamino]phenyl]-N'-(2-bromophenyl)urea  
 N-[2-[2-(4-Phenoxyphenyl)sulfonylamino]phenyl]-N'-(2-bromophenyl) urea  
 N-[[2-(1S)-10-Camphorsulfonylamino]phenyl]-N'-(2-bromophenyl)urea  
 10 N-[[2-(1R)-10-Camphorsulfonylamino]phenyl]-N'-(2-bromophenyl)urea  
 N-[2-[2-(2-Nitro-(4-trifluoromethyl)phenyl)sulfonylamino]phenyl]-N'-(2-bromophenyl)urea  
 N-[2-(2-Amino-(4-trifluoromethyl) phenyl) sulfonylamino] phenyl]- N'-(2-bromophenyl)urea ; or  
 N-[2-(aminosulfonyl phenyl) 3-amino phenyl] N'-(2-bromo phenyl) urea.

15

25. A pharmaceutical composition comprising a compound according to any of Claims 20 to 24 and a pharmaceutically acceptable carrier or diluent.

26. A compound of the formula:

20



wherein

X is oxygen or sulfur;

X<sub>1</sub> is oxygen or sulfur;

- 25 R<sub>1</sub> is independently selected from hydrogen; halogen; nitro; cyano; halosubstituted C<sub>1</sub>-10 alkyl; C<sub>1</sub>-10 alkyl; C<sub>2</sub>-10 alkenyl; C<sub>1</sub>-10 alkoxy; halosubstituted C<sub>1</sub>-10 alkoxy; azide; S(O)<sub>t</sub>R<sub>4</sub>; hydroxy; hydroxyC<sub>1</sub>-4alkyl; aryl; aryl C<sub>1</sub>-4 alkyl; aryloxy; aryl C<sub>1</sub>-4 alkyloxy; heteroaryl; heteroarylalkyl; heterocyclic, heterocyclicC<sub>1</sub>-4alkyl; heteroarylC<sub>1</sub>-4 alkyloxy; aryl C<sub>2</sub>-10 alkenyl; heteroaryl C<sub>2</sub>-10 alkenyl; heterocyclic  
 30 C<sub>2</sub>-10 alkenyl; NR<sub>4</sub>R<sub>5</sub>; C<sub>2</sub>-10 alkenyl C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>10</sub>; S(O)<sub>3</sub>H; S(O)<sub>3</sub>R<sub>8</sub>; C<sub>1</sub>-10 alkyl C(O)R<sub>11</sub>; C<sub>2</sub>-10 alkenyl C(O)R<sub>11</sub>; C<sub>2</sub>-10 alkenyl C(O)OR<sub>11</sub>; C(O)R<sub>11</sub>; C(O)OR<sub>12</sub>; OC(O) R<sub>11</sub>; NR<sub>4</sub>C(O)R<sub>11</sub>; or two R<sub>1</sub> moieties together may form O-(CH<sub>2</sub>)<sub>5</sub>O- or a 5 to 6 membered unsaturated ring;

t is 0, or an integer having a value of 1 or 2;

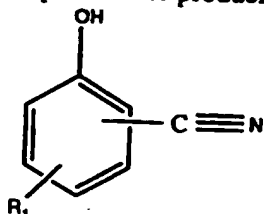
- 35 s is an integer having a value of 1 to 3;



- R<sub>4</sub> and R<sub>5</sub> are independently hydrogen, optionally substituted C<sub>1-4</sub> alkyl, optionally substituted aryl, optionally substituted aryl C<sub>1-4</sub>alkyl, optionally substituted heteroaryl, optionally substituted heteroaryl C<sub>1-4</sub> alkyl, heterocyclic, heterocyclic C<sub>1-4</sub> alkyl, or R<sub>4</sub> and R<sub>5</sub> together with the nitrogen to which they are attached form a 5 to 7 member ring which may optionally comprise an additional heteroatom selected from O/N/S;
- Y is independently selected from halogen; nitro; cyano; halosubstituted C<sub>1-10</sub> alkyl; C<sub>1-10</sub> alkyl; C<sub>2-10</sub> alkenyl; C<sub>1-10</sub> alkoxy; halosubstituted C<sub>1-10</sub> alkoxy; azide; S(O)<sub>t</sub>R<sub>4</sub>; hydroxy; hydroxy C<sub>1-4</sub>alkyl; aryl; aryl C<sub>1-4</sub> alkyl; aryloxy; arylC<sub>1-4</sub> alkyloxy; heteroaryl; heteroarylalkyl; heteroarylC<sub>1-4</sub> alkyloxy; heterocyclic, heterocyclic C<sub>1-4</sub>alkyl; aryl C<sub>2-10</sub> alkenyl; heteroaryl C<sub>2-10</sub> alkenyl; heterocyclic C<sub>2-10</sub> alkenyl; NR<sub>4</sub>R<sub>5</sub>; C<sub>2-10</sub> alkenyl C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>5</sub>; C(O)NR<sub>4</sub>R<sub>10</sub>; S(O)<sub>3</sub>H; S(O)<sub>3</sub>R<sub>8</sub>; C<sub>1-10</sub> alkyl C(O)R<sub>11</sub>; C<sub>2-10</sub> alkenyl C(O)R<sub>11</sub>; C<sub>2-10</sub> alkenyl C(O)OR<sub>11</sub>; C(O)R<sub>11</sub>; C(O)OR<sub>12</sub>; OC(O) R<sub>11</sub>; NR<sub>4</sub>C(O)R<sub>11</sub>; or two Y moieties together may form O-(CH<sub>2</sub>)<sub>5</sub>O- or a 5 to 6 membered unsaturated ring;
- n is an integer having a value of 1 to 2;  
 m is an integer having a value of 1 to 3;  
 R<sub>8</sub> is hydrogen or C<sub>1-4</sub> alkyl;  
 R<sub>10</sub> is C<sub>1-10</sub> alkyl C(O)<sub>2</sub>R<sub>8</sub>;  
 R<sub>11</sub> is hydrogen, C<sub>1-4</sub> alkyl, optionally substituted aryl, optionally substituted aryl C<sub>1-4</sub>alkyl, optionally substituted heteroaryl, optionally substituted heteroaryl C<sub>1-4</sub>alkyl, optionally substituted heterocyclic, or optionally substituted heterocyclic C<sub>1-4</sub>alkyl;
- R<sub>12</sub> is hydrogen, C<sub>1-10</sub> alkyl, optionally substituted aryl or optionally substituted arylalkyl; provided that:
- when n=1 than Y is substituted in the 2'- or 3'- position;  
 when n=2 than Y is di-substituted in the 2'- 3'- position;  
 further provided that  
 when X<sub>1</sub> is S, m=1, R<sub>1</sub> is 4-ethyl, and n=1 than Y is not 2-methoxy;
- or a pharmaceutically acceptably salt thereof.
27. The compound according to Claim 26 wherein R<sub>1</sub> is substituted in the 3-position, the 4- position or di-substituted in the 3,4- position by an electron withdrawing moiety.
28. The compound according to Claim 26 or 27 wherein Y is mono-substituted in the 2'- position or 3'- position, or is disubstituted in the 2' or 3' position of a monocyclic ring.
29. The compound according to Claim 26 or 27 wherein n and m are each equal to 1 or more.

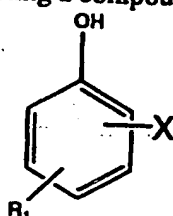
30. A pharmaceutical composition comprising a compound according to any of Claims 26 to 29 and a pharmaceutically acceptable carrier or diluent.

5 31. A process for producing a cyano phenol derivative of the formula:



wherein R<sub>1</sub> is as defined for Formula (I) above, which method comprises

a) reacting a compound of the formula:



wherein X is halogen

10 with copper (I) cyanide, dimethylformamide, triethylamine and a catalytic amount of dimethylamino pyridine.

32. The process according to Claim 31 wherein the temperature is about 60 to about 80°C, and X is bromine.

15

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US96/02260

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(6) :A61K 31/17

US CL :514/585, 596, 597, 598

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 514/585, 596, 597, 598

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Please See Extra Sheet.

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X, A	US, A, 4,048,333 (GALABOV ET AL) 13 SEPTEMBER 1977, see entire document.	9, 20-24, 26-29, 1-8, 11-13
X, A	Chemical Abstracts, Volume 122, No. 7, issued 13 February 1995, Olesen et al, "Preparation of arylurea and amide derivatives and their use in the control of cell membrane potassium channels" see page 1042, column 2, abstract no. 80891s, WO, A, 94/22807.	1-9, 11-13, 26-29, 20-24



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:	*T	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
*A* document defining the general state of the art which is not considered to be of particular relevance	*X*	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
*E* earlier document published on or after the international filing date	*Y*	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
*L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reasons (as specified)	*Z*	document member of the same patent family
*O* document referring to an oral disclosure, use, exhibition or other means		
*P* document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search

16 APRIL 1996

Date of mailing of the international search report

01 JUL 1996

Name and mailing address of the ISA/US  
Commissioner of Patents and Trademarks  
Box PCT  
Washington, D.C. 20231

Authorized officer

WILLIAM J. ARVIS

Facsimile No. (703) 305-3230

Telephone No. (703) 308-1235

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US96/02260

## Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☒ Claims Nos.: 10, 27(renumbered 25), and 30  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Please See Extra Sheet.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:  
1-9, 11-27 renumber to 25, 28 renumber to 26 and 27-29.

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.  
☐ No protest accompanied the payment of additional search fees.

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US96/02260

### B. FIELDS SEARCHED

Electronic data bases consulted (Name of data base and where practicable terms used):

STN: REGISTRY(STRUCTURE), CA

search terms: chemokine, interleukin, IL-8, psoriasis, dermatitis, asthma, arthritis, colitis, septicemia, stroke, reperfusion, thrombosis, alzheimer's disease, graft vs. host, allograft rejection

### BOX II. OBSERVATIONS WHERE UNITY OF INVENTION WAS LACKING

This ISA found multiple inventions as follows:

- I. Claims 1-13, 20-24, 27(renumbered 25), 28(renumbered 26), 27-30, drawn to methods and compounds thereof
- II. Claims 14 and 15, drawn to compounds and a pharmaceutical composition
- III. Claim 16, drawn to a method
- IV. Claims 17 and 18, drawn to compounds and a pharmaceutical composition
- V. Claim 19, drawn to a method
- VI. Claims 31 and 32, drawn to a process for making compounds

The inventions listed as Groups I-VI do not relate to a single inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: There are three different groups of compounds claimed with each group having basic structures considerably different than the others. Although all of the compounds (except those in the last two claims) have a common urea core, the variance in carbocyclic and heterocyclic rings of the core results in each group of compounds being distinct from the others. This is further made evident by the fact that the skilled artisan would not expect that the compounds of the three groups would have similar biological activity. Clearly, the three groups of compounds and pharmaceutical compositions, and the corresponding groups of methods, do not have a common technical feature and therefore lack unity of invention. Applicant should note that two sets of claims were numbered 27 and 28. Since it appears that the first set of claims were intended to be numbered 25 and 26, all four claims have been examined for lack of unity.